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Thinking Social Service and Early Childhood Education in Brazil

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Abstract *— This work presents the results of a narrative literature review, which aimed to investigate the importance of Social Work in Early Childhood Education. This objective is part of the guiding question proposed to carry out the research, which asks: What is the role of Social Work in Early Childhood Education? In this sense, we carried out a research with a qualitative and descriptive approach. The study analyzed five academic productions between articles and monographs and as main results it points out that the presence of Social Work in Early Childhood Education institutions can enhance the struggle for children's social rights and favor the development of a conscious and emancipatory education, thinking about comprehensive care of your audience.*

I. INTRODUCTION

Over the years, humanity began to develop its understanding of the importance of education in a systematic way and based on its own methods. This education begins to be offered in a formalized, institutional way and with the use of appropriate materials for the purpose of teaching-learning school-age children and young people.

Thus, studies on Early Childhood Education have been expanding in recent years with different approaches and from different areas of knowledge such as

Psychology, Public Management, Anthropology, Sociology, Law and Social Work itself.

These different areas of knowledge address issues that consider the need for professional training based on understanding childhood as an essential step in the process of sociability for children and respect for their rights.

Thus, throughout this work we make a brief journey of Early Childhood Education and Social Work, and then think about how the ethical-political project of Social Work can contribute to an improvement in this stage of teaching.

II. EARLY CHILDHOOD EDUCATION IN BRAZIL

Early childhood education is an achievement and a right of Brazilian children, it is guaranteed by the federal constitution of 1988 and the Law of Guidelines and Bases of National Education (LDB) 9,394/96, despite this, it still has numerous challenges that need to be overcome. Such challenges range from infrastructure conditions to the professional training of people who work at this level of education.

It must be said that the challenges posed in Brazilian Early Childhood Education are still remnants of old educational policies, which requires saying a development of policies that over time were developed with different objectives, as they were either aimed at welfare and compensation, or they were based on the need for preparation for literacy, integral formation of the child, etc. (NUNES, 2009; OLIVEIRA, 2007; ROCHA, 2009).

It is not contradictory, however, if we state that the origin of children's spaces institutionalized as day care centers is also related to female work and that this view is also permeated by sanitary and philanthropic concerns. In addition, the emergence of day care centers had

contributions from medicine and social assistance, in which the work carried out there was aimed at working with hygiene, issues related to food and physical care, but the pedagogical aspects were not addressed.

For the wealthier classes, however, "kindergartens" were created, whose proposal stood out for the ideas of recreation and child autonomy. However, in the mid-twentieth century, while children from low-income classes are inserted in school spaces, showing an inadequate profile with regard to age-appropriate learning, pre-school becomes a stage with compensatory and specific characteristics. preparatory, in which this stage is assumed, aimed at developing the skills needed to adapt to the school routine that would be later.

To work professionally at this level of education, with children aged 4 to 6 years, the training required was only the 2nd degree teaching course, which enabled the development of psychomotor activities; on the other hand, work with younger children (0 to 3 years old) was carried out by anyone without professional qualifications.

However, in the second half of the 20th century, around 1970 and 1980, the government turned its attention to pre-school education, bringing an administrative concern, a concern that will generate interest in building an education policy preschool, aiming at legitimizing and organizing adequate to this level of education

In this way, the preschool in the public network expands, despite its compensatory character, which requires saying that there is an absence of the necessary attention to the pedagogical nature and also permeated by the absence of effective professional training policies, which, according to Lobo (2011) still entails a care and compensatory focus, that is, a neglect of "[…] human resources and the absence of government projects and proposals and the creation of training courses for professionals" (LOBO, 2011, p.141) .

It is in this sense that the 1981 National Program for Pre-School Education promotes a new function for the education of children aged 0 to 6 years: pre-school with objectives in itself, as it moves away from the preparatory function and whose focus is from the perspective of overcoming children's problems caused by the lack of access to other policies, in view of the conditions imposed by social class, which also requires saying that the pedagogical capacity was not required, but technical mastery and control over the children, in addition to the willingness to the performance (ALVES, 2011).

Still in this scenario, questions about which pedagogical proposal followed, the pedagogical resources that would be used, as well as the number of children in the classroom and, above all, professional qualification for working in day care centers and preschools, are marginalized.

In the late 1980s and 1990s, with the Federal Constitution (1988), the Child and Adolescent Statute (1990) and the LDB 9,394/96, the care of children aged 0 to 6 years in collective spaces becomes legitimated as a child's right to education, and this service is incorporated into education systems. In addition, the Statute of Children and Adolescents (ECA), created in 1990 to replace the 1979 Minors Code, brought changes to the treatment given to children, taking a more focused look at the full protection and universalization of social policies, also proposing the recognition of the rights of children and adolescents, people in a peculiar condition of development "[…] as subjects of rights,

In these terms, the reaffirmation of the centrality of education in documents and in the definition of government policies is strategic and makes possible a perception of educational perspectives that are simultaneously articulated, with the idea of continuing education in the first place, which overcomes the obstacles posed by the borders of times and places destined to learning, reaffirmed by LDB 9.394/96, establishing the recognition and certification of learning from spaces beyond the school space (ALVES, 2011).

In this sense, several policies related to this new appearance of the education system are assumed, such as reformulations in the production, acquisition and distribution policies of textbooks, assessment systems, curriculum reforms, teacher training, incentive policies to degree courses at universities, etc.

Regarding the understanding of Early Childhood Education in the Federal Constitution (CF) of 1988, it is possible to say that the FC brings a favorable discussion to the construction of an educational policy in the country, as it considers Early Childhood Education as a child's right, a family option and duty of the state. With this new look, Early Childhood Education leaves an assistencialist bias, in the daycare segment, to be assumed as a child's right.

This achievement is endorsed by the ECA, 1990, and the LDB. As the first reinforces the citizenship of the child and provides changes in the way of thinking about childhood in Brazil, as the second asserts early childhood education as an important stage in human development, which requires saying that it is this law that includes Early Childhood Education in basic education, determining what training and professional qualification should be carried out to work in the area.

It is true, however, that some works such as Corsino's; Nunes (2010) and Alves (2011), for example, celebrate the departure of Early Childhood Education from the sphere of Social Assistance, claiming that it is characterized by care. As Corsino claim; Nunes (2010, pp. 1-2), the Brazilian

system chose to integrate the care of children aged 0 to 6 years in the sphere of education, realizing that this "[…] is the result of a historical process of articulation between two dimensions: one social, political and administrative and the other technical-scientific, understanding education and care as inseparable, since the same act that takes care educates, the same act that educates takes care".

III. THE SOCIAL SERVICE AND ITS ETHICAL-POLITICAL PROJECT

With its appearance in the 1930s, the Brazilian Social Service took years to be regulated as a profession, as higher education was only regulated in 1953 and only in 1962 came the regulation of the profession by Laws nº. 3252 of 1957 and Decree no. 994 of May 15, 1962 (FELIPPE, 2018).

Since its beginning and regulation, Social Work in Brazil has undergone several changes to the present day, as in the early history of Brazilian Social Work, this area, in its philosophical and practical basis, maintained a direct relationship with the Catholic Church, in addition to being influenced by trends from North America.

Realizing the need for changes in professional performance, social workers over time have brought to the fore the importance of building a project seeking to contemplate people individually and collectively in Brazilian society and, thus, this project was called the Political Ethical Project of Profession.

This new project began in 1970, bringing as a historic landmark the realization of what became known as "Congresso da Virada" (III CBAS). After this beginning, the construction of an ethical-political project of Social Service progressed through the 1980s, when, with the end of the military dictatorship, Brazil went through the process of redemocratization.

In the following decade, 1990, the construction of the Political Ethical Project of Social Work gained greater force, even though the expansion of neoliberalism was under way in the country. In other words, the consolidation of the Ethical Political Project of Social Work takes place in a scenario "[…] strongly tensioned by the neoliberal paths of society and by a new conservative reaction within the profession in the current decade" (TEIXEIRA; REIS, 2009, p. 13).

In this sense, it is worth noting that the Ethical Political Project of Social Service is committed to a democratic project of society, with a view to guaranteeing the universal rights of its nation based on the Federal Constitution of 1988, the Universal Declaration of Human Rights and other international agreements for the guarantee of human dignity.

In addition, the Social Work Ethical Political Project seeks to break the conservative practices of acting in society and in the construction of social policies. It is in this sense that Yasbeck (2004) considers that the construction and consolidation of the Political Ethical Project of Social Work presupposes the articulation of different ethical spheres.

In these terms, we can consider that there are many challenges posed to the exercise of social service, especially when the corporate project diverges from what is set and seeks to build a profession with a critical social aspect, as the need to build "[...] a role of politicizing and giving visibility to the interests of the subaltern classes and we know that the high technical quality of our work is not enough" (YASBECK, 2004, p.12).

Thus, it is important to consider that the construction of an Ethical Political Project of Brazilian Social Work presupposes considering some fundamental factors, such as, for example, the consolidation of democracy in line with the social issue and the articulation between Social Work and the Social Sciences , especially nowadays, when democratic institutions, the Social Sciences and the Human Sciences are threatened.

IV. BUILDING A NEW SOCIETY UNDER THE VIEW OF SOCIAL SERVICE

Currently, many debates have been raised about Brazilian society being aligned with a corporate project. In general, corporate projects can assume a transformative or conservative character and, obviously, the Political Ethical Project of Brazilian Social Work is linked to the transformation of society and, in this sense, the professional project of Social Work in Brazil is effectively linked " […] to a societal project that proposes the construction of a new social order, without domination and/or exploitation of class, ethnicity and gender" (NETTO, 1999, p. 105).

This link affirmed by the author is a requirement arising from the ethical presuppositions and the political dimension assumed in the face of the demand of the Social Work's own professional performance, but this also requires mentioning the challenges posed to the execution of such a project.

In these terms, the ethical-political project of Social Work is assertive in pointing out the social commitments of the profession, asserting its professional commitment in an ethical, political and social field that dialogues "[…] with the autonomy, emancipation and full expansion of individuals social. (NETTO, 1999, p. 104). In other words, the presence of the Social Service in articulation with other sectors of society favors the evolution of Brazilian society as a nation, seeking to understand the social issue, as well

as the transformation of the structures placed in Brazilian society.

Considering these elements, we can say that for Social Work to think about social transformation, it is necessary to think about an Ethical Political Project based on the freedom of people as subjects of rights. It also requires that this project be articulated with the commitment to people's autonomy and social emancipation, proposing the transformation of society through the construction of a new order supported by equity and social justice (NETTO, 1999).

In addition, it is necessary that the Social Service continually act to expand the social rights conquered over time, reinforcing the need for "socialization of the wealth produced and the political participation of the population in the formulation of public policies" (SANT'ANA, 2016 , p. 28).

In addition, the professional performance to promote this social transformation through Social Service, it is necessary that there is a multidisciplinary action agenda in recognition of the agenda of other professional categories that act in defense and emancipation of the working class, building the confrontation to the discrepancies put forward for the social issue.

Such discrepancies are inserted in all sectors of Brazilian society, which means that one of the possible paths for the insertion of Social Work is education itself, also seen as one of the great possibilities of social reorganization.

In this way, the role of Social Work as a path to social transformation can and should be included in the Education Policy, acting together, in a multi and interdisciplinary way, as we have already stated, with a view to contributing to the transformation of social structures, guaranteeing rights , rethinking situations of social injustice and building an egalitarian society.

V. CONCLUSIONS

We conclude from this work the need to create policies that enable the insertion of people who act as social workers in public education directly in schools and Early Childhood Education centers in Brazil, in order to guarantee the rights already conquered and face daily confrontation to the dismantling that the public service, especially those aimed at serving less wealthy populations, is facing.

Therefore, we can say that the role of Social Work in Early Childhood Education is directly linked to the guarantee of rights, which means that, throughout the work, we shed light on our question initially proposed in the research.

There are still questions that can and should be deepened in future research, such as, for example, trying to understand if the public policies developed so far favor this insertion of people who work in Social Work focused on Early Childhood Education and how they are applied.

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Work, health and vulnerabilities of riverside women in the brazilian amazon in COVID-19 pandemic

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Abstract *— Objective: This study aimed to describe aspects related to work, health and vulnerabilities of riverside women in the Brazilian Amazon during the COVID-19 pandemic. Method: This is a narrative review through the search for articles in scientific databases, published from January 2020 to October 2021. Five complete original articles were selected that answer the central question of the research and were organized according to the content of their evidence, divided into three categories: 1) The work of riverside women in the context of COVID-19; 2) The impact of work on the health of riparian women in the face of the pandemic; 3) Vulnerabilities of riverine women and coping strategies in the pandemic. Results: The analysis of the literature highlights important points in the sense of alerting society to the vulnerabilities to which women are exposed due to the social isolation imposed by the pandemic, such as the loss of income with a direct impact on the families' food and quality of life, violence domestic, mental disorders, among others. Conclusion: It is concluded that this review opens paths and perspectives for a better understanding of the problem and planning of public policies aimed at the needs of riverside women in the Amazon.*

I. INTRODUCTION

Currently, the world is facing one of the most complex health crises of contemporaneity, characterized by the Sars-Cov-2 virus, which causes COVID-19 [1]. The advance of the pandemic has had several repercussions for the multiple faces of society, and the work that makes up one of these faces has been highlighted due to the impacts that have only grown in the course of the health crisis. Organizations such as the ILO (International Labor Organization) estimate that around 1.6 billion workers in the informal economy (almost half of the global workforce) are at imminent risk of being left without their livelihoods. In this context, Latin America is one of the regions most affected by the pandemic. [2]

The tendency is for the context of the worker to be even more challenging in the midst of the global economic recession, especially with regard to guaranteeing informal workers, who are already vulnerable in terms of working conditions and access to income, due to measures of social distancing. [2]

It is noteworthy that the groups most likely to lose their jobs during the pandemic are women and young people, with relevant differences in color and education. The proportion of blacks and browns who lose their jobs is always above average and reached 18% at the beginning of the crisis. [3]

In this context, it is necessary to understand the concept of gender, which arises precisely to break the biological determinism in the attribution of social roles, consolidating itself as an important analytical instrument to give visibility to the historical and sociocultural character of male and female roles and spaces by revealing the material and symbolic bases of inequalities between men and women. [4]

Silva and Steward (2019) point to gender as essential to understand the dynamics of development in all its dimensions, as it reveals basic aspects of the organization and distribution of production and work. [4]

Therefore, it is necessary to have a careful and thorough look at the impacts of the COVID-19 pandemic on some specific populations, such as the peoples of the Amazon, which are represented by a strong symbolism, whether cultural, social or work. Land and water are constitutive elements of this culture. Waters are dominant in the life of riverside dwellers and in the Amazonian landscape, characterized by flowing rivers and tributaries. [5] The identity of riverside dwellers is a product of what they are in the present, and contrasts with what they were in the recent past. [6]

These populations gather and develop specific forms of knowledge and practices acting on the various agro-ecosystems, accumulating different knowledge and skills about the complex swidden-forest-river-igarapé-backyard. In several communities in the Amazon floodplain, fishing and agricultural activities that govern the local economy predominate. [7]

The daily experience of Amazonian women in agroextractive production activities provides us with important information on how they daily reinvent ways of taking care of life. [7] The extraction of açaí and palm hearts, for example, is a practice of riverside life, which, combined with the extraction of cocoa, açaí, rubber, nuts, fish and shrimp, among other cultures, in addition to animal husbandry , form the identity of riverside dwellers. [5]

Regarding the work of riverside women, the research by Amaral (2016) carried out on the islands of Abaetetuba found that handicrafts made from gourds and shallows are women's tasks. The process of making the gourds starts from the youngest girls passed by the oldest and the weaving of the shallow ones requires knowledge and techniques that the women learn from each other, such as baskets, sieves, baskets. [7] Rodrigues et al. (2015) add that they have a unique "know-how", built, above all, from the establishment of a relationship with nature, based on oral and family tradition. [8]

Fechine (2008) explains that the invisibility condition of female work in riverside communities has been causing problems for women's access to public policies, such as the difficulty of recognition as a rural worker, when it comes to women who are not politically organized. [9]

Furthermore, the non-recognition of the mode of domestic production, in a consumption-oriented economy in rural areas, contributes to the 'invisibility' of women's work in family farming. [10] Recognizing the participation of rural women in the composition of family income means valuing their work, performed inside and outside the family unit and as active agents in the economy.

In order to understand work relationships, it is understood the activities performed by women that go beyond domestic spaces such as farms, handicrafts, extractivism, animal husbandry, cultivation of medicinal plants, among others. However, women are still only associated with domestic activities and men are responsible for productive and extractive activities. In reality, rural women's domestic work is not recognized as a contributing factor in the composition of family income.

Silva and Portella (2004) described that "women's agricultural work is conceived as "help" because it is considered outside their own attribution, which are domestic activities, [11] but because it is carried out daily, it is associated and almost confused with these, characterizing a double work shift for women, as even if they carry out agricultural or non-agricultural activities, housework will still be their responsibility, even if some tasks are shared by another family member. [12]

Knowing and giving visibility to the current health and work situation of riverine women in the Amazon becomes imperative, as a way of enabling the planning of intersectoral actions.

In the meantime, Primary Health Care (PHC) is recognized as a key component of health systems and is based on evidence of its impact on the health and development of the population in countries that have adopted it as the basis for their health systems: better health indicators, greater efficiency in the flow of users within the system, more effective treatment of chronic conditions, greater efficiency of care, greater use of preventive practices, greater user satisfaction and a reduction in inequities in access to services and the general state of health. [13]

Within this composition is structured the proposal of the Family Health Strategy (FHS), which aims to focus health care on the family, characterized from its physical and social space. Professionals establish contact with the health and living conditions of social groups, and may have a comprehensive understanding aimed at the health-disease process, as well as the intervention needs, not only performing curative practices. [13]

When the FHS provides greater attention to families, it performs two attributes of the PHC: cultural competence and family community orientation, broadly recognizing family needs, inherent to the physical, cultural and economic context. This aspect is particularly important when this health care refers to special populations, in this case, riverside communities and women, described as populations living on the banks of rivers, far from general culture. [13]

This study is justified, therefore, by the need to deepen the knowledge about the reality experienced by women workers during the COVID-19 pandemic, in particular because they reside in vulnerable regions of the Brazilian Amazon, which historically suffer from social inequalities.

Thus, the present study aimed to describe aspects related to work, health and vulnerabilities of riverine women in the Brazilian Amazon during the COVID-19 pandemic.

II. METHOD

The research is a narrative review, qualitative in nature. The narrative review is intended to describe the state of the art of a particular subject and allows for an expanded discussion.

The searches were based on the research question: What are the available scientific productions on aspects related to work, health and the vulnerabilities of riverine women in the Brazilian Amazon during the COVID-19 pandemic?

Next, the descriptors validated in DeCS/MeSH were used: "Work", "Health", "Women", "Amazon" and "COVID-19", using the Boolean operators AND or OR, published in January 2020 to October 2021.

The survey of bibliographic studies took place during the month of November 2021, in which original articles, literature review and opinion articles, published in national and international journals, published in Portuguese and English, available free of charge, were included in the study full text, in electronic format, in the Virtual Health Library (BVS), Scientific Electronic Library Online (SciELO), PubMed and Google Scholar databases.

Other types of studies such as conference abstracts, dissertations, theses, etc., and articles not published in full were excluded.

III. RESULTS AND DISCUSSION

In this narrative review, five original scientific articles were selected that strictly met the previously established sample selection and showed similarities with the object of this study. The findings were organized into three categories that address: 1) The work of riverside women in the context of COVID-19; 2) The impact of work on the health of riparian women in the face of the pandemic; 3) Vulnerabilities of riverine women and coping strategies in the pandemic.

The work of riverside women in the COVID-19 context

This category brings reflections on the consequences of COVID-19 on the work of riverside women in the Amazon. According to data from the National Household Sample Survey, [14] the highest rates of informality in the labor market among women occur in domestic service activities (73.1%) and in agriculture and livestock (74.6%). These activities are characterized by high informality due to the dynamics of hiring (seasonality, contract work, greater sensitivity to conjunctural factors, etc.). Regarding the cut by race/color, it indicates that the participation of the black and brown working population in informal occupations is significantly higher (47.3%) when compared to white workers (34.6%). [15]

One of the groups strongly affected by social isolation was the artisanal riverside fisherwomen, who, historically and even today, struggle to be recognized as fishermen both in terms of rights and in the social sphere. Many artisanal fishers call themselves 'shellfish gatherers', because the fishing that, in most cases, is given to women from the inland sea, estuaries, rivers and mangroves. In general, women have historically been directed to collecting fisheries, which are of shorter duration and which are geographically close to the house. [16]

The focus of the problem in question according to the feminine is important because the pandemic impacts the different working hours for women: as a fisherman and as a mother/wife. In this sense, women face the pandemic and social isolation on three scales: the community, the home and the body, which will be discussed one by one below. [2]

At the community scale, the issue of the woman's work as a fisherman is more evident, after all, the community is the base institution of fishing: the more family and kinship relationships are neighborly. The fishing carried out by the women is communal, because, in almost all cases, the fisherwomen fish in groups together with their neighbors, who may or may not have kinship ties. Although the collection is individual, the work is collective from leaving home until the search for better areas for collecting shellfish, crabs, etc. [2]

Work, for fisherwomen, is synonymous with sociability, freedom and autonomy, as it is the time when they are far from domestic activities and from their husbands and close to their co-workers. For women, fishing work is living, because the pandemic, through social isolation, made the situation unsustainable. Fishing, therefore, is a refuge, because of the benefits it brings to physical and mental health. Social isolation confines not only women, but much of the world in times of COVID-19. For women it is even more impactful because it is at home where their other workday takes place, as a mother and wife. Without fishing, the house becomes the center of attention. [2]

In times of daily normality, the woman spends much less time at home with her partner, who is almost always a fisherman and has long working hours at sea, and sometimes even with her son, as he studies and she has his other working day in fishing. With this new world imposed by the pandemic, the husband is included in the work and care of the house. [2]

This scenario demonstrates an important dimension of unpaid female work, which is often implied, that the woman is responsible for the house, and even more, for maintaining the well-being and control of everything that goes on in this space, as well as of the people who are and/or live there. [2]

The impact of work on the health of riverside women in the face of the pandemic

This category discusses the importance of women's health care provided in the Basic Health Units of the Riverine during the COVID-19 pandemic period.

This entire context of the pandemic supports the understanding of how the female body absorbs and feels this scenario of social isolation and are at the forefront of this issue. With confinement and, consequently, with the

increase in time indoors, there was a substantial increase in cases of domestic violence around the world, including the target population of this study. [2]

In artisanal fishing, the possible effects of confinement for women, such as depression and loneliness in the absence of fishing activity in their daily lives, many female bodies are subjected to domestic violence, which makes the period of isolation and issues related to the psychological more difficult. Working as a fisherman is a refuge for some of the fisherwomen who face this problem, as it confers freedom, autonomy and distance from the aggressors. [2]

Reflections on the importance of health, health care and problem detection becomes explicit, that health care is important to maintain the health state they want to have, including early detection for those who consider themselves healthy. The constructions of their perceptions are explained taking into account a whole context that really does not dissociate when thinking about quality healthcare with universal access. [13]

PHC is seen as the structural axis of the Brazilian Unified Health System (UHS) policy, which brings together individual and collective health actions, covering not only health promotion and protection, but also the prevention of injuries, diagnosis, treatment, rehabilitation and its maintenance. Seeking to expand coverage for universal service and promoting equity in health in Brazil, ensuring that individuals remain healthy and have the possibility of accessing care needs. [13]

The primary purpose of the FHS is to act as the main entry into the UHS, having as fundamental guidelines: to allow universal access to health, regardless of race, sex, religion, socioeconomic level and comprehensive care, considering the integration of all levels in a holistic way. In this way, the planning of health policies has been directing its strategies considering the premise that health care must address the peculiar needs of people and social groups, especially minorities, such as riverine women, which constitutes a dynamic challenge and permanent. [13]

This audience is unaware of existing public policies that ensure health rights based on strategies and practices in response to the needs of the population. It is important that riverside dwellers appropriate this knowledge about the policies, both of the PHC and of the ESF, being aware of their rights and duties. It is understood that the assistance of the multidisciplinary team in the transfer of knowledge is important in the collective context. [13]

The longitudinality of care requires a professional practice with an important degree of communication, interpretation, negotiation and shared responsibilities, stimulating the bond and expanding the access of riverside populations and the professionals' perceptions about their cultural singularities and care needs. [17]

In the dimension of clinical care, the conception of the quality of health care is still based on meeting their needs for curative practices, structural issues and shortage of human resources such as absence or irregularity in the transport of teams, lack of medical specialties, dentists and medicines.

The health care offered to the riverside population must consider their sociocultural peculiarities. In this context, the guidelines offered by health professionals are consistent with their way of life and culture, especially regarding the use of "home remedies", guiding them to reconcile the use of allopathic medicines with cultural practices. [13]

The islands around Belém, Pará, Brasil, have a different reality from the urban area, as despite being close to a metropolis, their way of life is based on the culture rooted in their daily lives, their customs, which influence their health-disease process and how they deal with these aspects. Popular knowledge considers the particularities of religiosity, food, territoriality, forms of interpersonal relationships and culture, influencing the therapy used, such as native herbal teas. [18]

Therefore, it is essential that the practices of professionals are in line with cultural issues inherent to the riverside population and that they have an attentive and differentiated look at the health needs of women, in order to promote holistic care. Therefore, this knowledge on the part of professionals focused on the knowledge and practices carried out by riverside dwellers enables better quality of health care. [13]

Despite the COVID-19 pandemic, it was found that women are unequally impacted, mainly by the growth in the number of cases of domestic violence and also by the increase in working hours, whose social isolation meant that women had to reorganize their routines daily resulting in mental and physical exhaustion represented by the excess of assignments. According to a report by the United Nations (UN) Women, released at the end of March 2020, women are among the groups most affected by the pandemic. [19]

Faced with this sad scenario, the UN (2020), to combat gender-based violence during the pandemic, recommends countries to increase online services, in the structure of judicial systems so that offenders are properly prosecuted, that emergency systems are created in locations such as pharmacies and markets, allowing easy access to support measures without alerting your attackers. [19] In Brazil, the Ministry of Women, Family and Human Rights stated that the confinement resulted in an increase in the number of

calls to 180, which handles allegations of violence against women. [20]

From the perspective of thoughts on gender equity, much has been said about the changes from generation to generation, with regard to the role of women in the social, family and professional context. We still live in a society with a patriarchal context, where the female figure is still often perceived by behavioral rules established by the archaic conservative culture. [21]

Twenty-first century women are linked to multiple functions, and in addition, they constantly struggle for their rights, which should be intrinsic. Usually the woman has already been reconciling long working hours, reconciling profession, housework and motherhood. In times of pandemic and social isolation, everything intensified and the current context proved to be challenging given the difficulties of quarantine. [21]

The remote work system, known as Home Office, through technologies, seems to have taken over most of the work, which has benefited many women, even amidst the difficulties of reconciling work with the routine at home. However, the work of the traditional riverside population is, in short, menial, and thus cannot comply with the norms of social isolation, and as a consequence, becomes more exposed to illness by COVID-19. [21]

Vulnerabilities of riparian women and coping strategies in the pandemic

In this category, the main factors that characterize the vulnerabilities that riverine women in the Amazon are exposed to were analyzed, in order to contribute to the reflection on the COVID-19 pandemic in the face of the asymmetries that such a global health emergency has been producing in contexts of inequalities in the Brazil. It is known that social inequalities place populations in more precarious situations of illness and death, the impact being different according to the place occupied by population groups in the social structure. [15]

It should be added that the place occupied by the segments in society has to do with historical issues, with the political and economic context and the social disparities produced according to social class, gender and race. The conditions in which people live, learn, work and play contribute to their health. These conditions, over time, lead to different levels of risks, needs and health outcomes. [22]

One of the determining factors, according to data from Brazilian Institute of Geography and Statistics, [23] is with regard to skin color, whose data indicate that the black population represents a significant portion of traditional communities, quilombolas, riverside communities, artisanal fishermen, those living on the streets , of people deprived of liberty, of those who live in extreme poverty and in households that do not meet the standards of habitability, that do not have water supply and/or sanitation as in the slums, of those who have lower incomes or who survive informally; those who depend on garbage of a recyclable nature or not, those who are in a situation of food insecurity; who have difficulties in accessing health, social assistance and education services and equipment. [23]

Health differences between racial and ethnic groups are often due to economic and social conditions that are more common among some racial and ethnic minorities than among whites. In public health emergencies, these conditions can also isolate people from the resources they need to prepare for and respond to outbreaks. [24]

In order to reverse the advance of COVID-19, scientific evidence points to the need for a paradigm shift in the implementation of actions for the prevention and control of the pandemic from the recognition of the moment of economic, political, ideological and moral crisis transversalized by racism . The consequences of the COVID-19 pandemic in a society structured by racism penalize vulnerable groups, especially among black people. This situation influences and directs political decisions and the development of social protection strategies, such as public policies in the social and health area. [15]

With regard to the different strategies for reducing the social vulnerability of black communities, there is a need for intersectoral articulation to guarantee the right to life in all its dimensions and to combat racism. Furthermore, community emergency actions can help meet basic needs, such as food and reducing food insecurity, improving housing conditions, hygiene and basic sanitation conditions in households, access to education and qualified information via the internet, occupation and income generation. All these aspects are directly related to access and accessibility to health services. [15]

When thinking about the pandemic from a gender perspective, important differences can be seen. Even though for some scholars COVID-19 can reach men and women indiscriminately, its effects widen unequal gender relations. Some studies have pointed out that infection and death rates are higher among men, without even greater biological explanations for the effect of the virus in the male body. It is debated that such data could be explained by the fact that men are more exposed on the streets and, historically, take care less of their health when compared to women. [25]

However, when we analyze the effects of the pandemic in the country more broadly, it is possible to see that women are the ones occupying the leaky side of the boat. With the population confined to homes, studies show an increase in violence against women in several Brazilian

states. [26] In addition, by delimiting the space of the house, women were responsible for taking care of household chores, children and work (teleworking or not). [25]

When analyzing the lower social classes, gender issues do not arise, as 40% of families are single-parent, headed by women. Thus, what is observed in the media are women in queues to withdraw emergency aid, on the streets and in public transport. [25]

Campaigns to combat violence or that encourage mutual cooperation between men and women have not been built considering race, ethnicity, sexuality and, especially, territorialization. As an example, we cite riverside women in Amazonas, who often head the families, need to move to urban centers to sell what they cultivate and live in stilt houses, with many residents, without space and without sanitation, in addition to living in societies where patriarchy is more deeply rooted. These are precisely the women who reside in the most remote regions, in the most precarious and needy conditions and who need more attention in public policies at this pandemic moment. [27]

Thus, at first, it is observed that the distancing measures, teleworking, contagion prevention information, social assistance alternatives, and contingency plan strategies, discussed so far, while aiming at protect a certain segment of society, leave others completely unprotected. These are people who will continue working, will remain very close to each other, will not wash their hands and, even if they get sick, they will probably continue in the same situation, since in the informal market there is no protection. The moment is crucial for us to rethink life in society and how the concept of collectivity has been incorporated in our environment. [27]

IV. FINAL CONSIDERATIONS

From this study, it was possible to discuss some of the priority aspects related to the work and health of riverine women in the Amazon in the outbreak of the COVID-19 pandemic.

The scientific evidence reported in this review does not answer all the questions, but open paths and perspectives for a better understanding of the problem, in the sense of alerting society to the vulnerabilities to which women are exposed due to the social isolation imposed by the pandemic, example of loss of income with a direct impact on families' food and quality of life, domestic violence, mental disorders, among others. It is concluded that this review opens paths and perspectives for a better understanding of the problem and planning of public policies aimed at the needs of riverside women in the Amazon.

Furthermore, it is recommended, as a proposal, new studies in the area, mainly field and observational studies, in order to know the reality and experiences of women belonging to the Amazon region and other regions of Brazil.

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Challenges and Opportunities for Collectors of Recyclable Materials in the Municipality of Guajará-Mirim / Rondônia: A visualization based on the Ucinet tool

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***Abstract*—** *The research aims to describe the profile of recyclable material collectors and the possible impacts generated in the municipal landfill of Guajará-Mirim and the perception of environmental risks. From a methodological point of view, questionnaires were applied to stakeholders (pickers, small traders and the recyclable materials manager), which allowed a broader view of the recycling process and the organizational and technological level employed in this economic segment.For this, the UCINET Software and NetDraw tool was used, where it was possible to analyze the data and social networks around the recyclable materials sector in the "green city" of Guajará-Mirim, Rondônia, Brazil. Thus, allowing to consider that this activity is very fragile from a technical, technological and organizational point of view, which makes it a great threat to the sector. Furthermore, factors such as public policies, environmental awareness and cooperation seem to further undermine this important activity in the municipality, which increases the local paradox in relation to the national solid waste policy.*

I. INTRODUCTION

In the context of current environmental problems, solid waste has caused concern at municipal, state and federal levels due to rampant consumption and wrong disposal, as most of it goes to open dumps. Several studies show that the population's living standards are strongly influenced by technological advances and, in order to meet the needs imposed by a consumer-oriented society, there have been numerous changes in the environment and, consequently, in human health [1]. So, with the arrival of new products on the market, society starts to acquire more modern products.

The great challenge currently is how to manage solid waste management efficiently and apply the objectives and instruments of the National Solid Waste Policy (PNRS), Law nº 12.305/2010[2]. The law instituted the National Solid Waste Policy - PNRS has as priorities the reduction of the volume of generated waste, the expansion of recycling, allied to selective collection mechanisms with social inclusion of collectors and the extinction of dumps. In addition, it provides for the implementation of sanitary landfills that will only receive waste, which cannot be reused.

Within the concept of environmental responsibility, the PNRS law establishes the bases for a practice of shared vision between the government, companies and the population, as it requires the return of products to industries after consumption and requires the government to carry out waste management plans. One of the hallmarks of this management is the social bias, with the participation of collectors who can be hired through municipal cooperatives, for collection and recycling.

For Buarque [3], achieving sustainability requires a process of social change and increased opportunities for society, making compatible, in time and space, economic growth and efficiency, environmental conservation, quality of life and social equity , based on a clear commitment to the future and solidarity between generations.

Authors such as Cruz [4]; Veiga; Silva and Hilton [5]; Le Prestre [6]; Machado [7]; Moradilho and Oki [8]; Marques [9]; Lago [10]; Brusek [11]; Tozoni-Reis [12] highlights the importance of the 1st World Conference on Environment and Development, held in Stockholm, Sweden, in 1972 as a historic landmark for a new vision on the environment and development. At ECO-92, several proposals were approved, such as: the conversion of biodiversity, climate change, and the most important were the signatures of agenda 21, which deals with the action plan with goals for the improvement of the planet's environmental conditions. The Rio+20 conference held by the UN had as its main theme "Sustainable Development" – development that fully integrates the need to promote prosperity, well-being and protection of the environment. During the conference, several debates and discussions heated up Rio+20, so that in the end a consensus was reached and everyone signed the final document agreed by 188 countries, which sets the path for international cooperation on sustainable development.

Lago [10]; Moradilho and Oki [8] raise the question in Brazil of its natural potential, saying: "Brazil had great participations in international meetings on environmental education, even for acting within the united nations system. Since Brazil has interesting resources in the eyes of other countries, it is the target of constant attention, for its large reserves of drinking water, as well as for covering a large part of the planet's biodiversity".

A real fact is that the topic of solid waste is currently one of the greatest environmental concerns. Societies in general are consuming more and more, and with that they advance in a way that destroys natural resources, and consumer goods, in general, have a shorter useful life, or are simply discarded for more modern ones. As a result, there is an increase in waste that is mostly disposed of in the wrong way and goes to open dumps.

In this context, the issue of solid waste also received specific treatment in Brazilian legislation. Solid waste is understood as those that are: In solid and semi-solid states, which result from activities of the community of origin industrial, domestic, hospital, commercial, agricultural, service and sweeping. This definition includes sludge from water treatment systems, those generated in pollution control equipment and installations, as well as certain liquids whose particularities make their release into the public sewage system or water bodies unfeasible, or require for this technically and economically unfeasible solutions given the best available technology [13].

The World Health Organization (WHO) defines solid waste as anything that the owner no longer wants, in a certain place and at a certain time, and that has no current or perceived commercial value. The National Solid Waste Policy Law number 12,305, of August 2, 2010, in article third, item XVI, provides: solid waste: material, substance, object or discarded property resulting from human activities in society, whose final destination is proceeded, it is proposed to proceed or is obliged to proceed, in solid or semi-solid states, as well as gases contained in containers and liquids whose particularities make its release into the public sewer system or water bodies unfeasible, or require solutions that are technically or economically unfeasible given the best available technology.

According to the National Solid Waste Policy, in a view of the Brazilian reality, the Legislation that deals with the constructive aspects of sanitary landfills is recent in Brazil. On November 11, 2008, Resolution No. 404 of the National Council for the Environment (CONAMA) was published, which provides for the environmental licensing of small-scale sanitary landfills for solid urban waste [14]. Among the federal legal instruments, it is worth mentioning the law 11,445 of January 2007, which establishes the national guidelines for basic sanitation and for the federal basic sanitation policy. According to Law 11.445/2007, in art. 2 says that users organized in cooperatives or associations can be hired as providers of basic sanitation services (which includes collection, transshipment, transport, sorting, recycling, composting, final disposal, and eventual urban public cleaning services), provided that limited to a specific condominium or small location. Decree 5940, of October 25, 2006, institutes the separation of recyclable waste discarded by bodies and entities of the direct and indirect federal public administration, at the generating source, and its destination to associations and cooperatives of recyclable material collectors. According to information from the National Survey of Basic Sanitation carried out by the Brazilian Institute of Geography and Statistics (IBGE), only 27.7% of Brazilian cities had landfills, 22.5% had controlled landfills and 50.8% of cities dumped waste produced in dumps. In Brazil, 13% of urban waste is recycled. However, the potential for recycling is much greater. According to studies by the federal government's IPEA (Institute for Applied Economic Research), it indicates that the country loses R$ 8 billion annually by burying recyclable materials that can return to industrial production. In addition to the economic aspects, recycling saves natural resources, such as water, in addition to providing the rational use of energy and less emission of greenhouse gases. The Federal Constitution of Brazil of 1988 consolidates the legal and institutional process in Chapter VI, which deals with the Environment, emphasizes the need for its defense and protection and seeks to establish tools for this to occur, pursuant to art. 225 of the Federal Constitution. According to the Federal Constitution of Brazil of 1988 [15] in Art. 225 – Everyone has the right to an ecologically balanced environment, a good for common use by the people and essential to a healthy quality of life, imposing on the Public Power and the community the duty to defend and preserve it for those present and future generations.

One of the economic and financial mechanisms is reverse logistics. In Brazil, about 50.8% of municipalities still use dumps as a form of disposal of urban solid waste, 22.5% use controlled landfills and only 27.7% dispose of waste in landfills. There are countless difficulties faced by 5,565 Brazilian municipalities in collecting solid waste. Only about 900 have the selective collection service. In Rondônia, productivity is low: only 12% of what is collected is recycled. This theme has been worked on at the state level and supervised by the Court of Accounts of Rondônia - TCE RO. In November 2015, the TCE RO prepared, through the General Secretariat for External Control (SGCE / DCA), a survey with municipal administrations, identifying that, of the 52 municipalities in Rondônia, 41 still use "open-air dumps", while 11 are landfill use, most in the form of a consortium. The survey also pointed out that all municipalities carry out collection services, whether they are themselves (30), outsourced (19) or in a consortium (3).

All these environmental challenges and lack of solid waste

management are evidenced in other municipalities, and this scenario can also be observed in Guajará-Mirim, State of Rondônia. Although Guajará-Mirim in 2009 received the title of "Green City" granted by the Environmental Institute of Biosphere, due to its mosaic and its extensive protected area, which makes the municipality one of the most preserved, in terms of preserved areas, the municipality does not comply with environmental principles. Guajará-Mirim is located in the western region of the state of Rondônia, on the right bank of the Mamoré River, a region where 93.7% are areas of environmental protection [16]. It has 41,656 inhabitants and an area of 24,856 km², being the second largest municipality in territorial extension and the eighth largest in population in the State of Rondônia.

According to Zanta and Ferreira [17], the open-air solid waste deposit or dump is a form of disorderly deposition without compaction or coverage of the waste, which promotes soil, air and water pollution, as well as the proliferation of vectors of waste illnesses. In turn, the controlled landfill is another form of waste disposal, with the only care being to cover the waste with a layer of soil at the end of the daily workday, with the objective of reducing the proliferation of disease vectors.

In this context, the study was guided by the problematization of solid waste management, and social and environmental externalities (garbage and poverty) in a scenario of vulnerability of solid waste collectors and the role of the public sector and the population in general. Thus, there is a need to know this activity in the solid waste segment and verify its limits and potential; perceptions and outline the profile of recyclable material collectors and their working conditions in the open-air dump in the municipality of Guajará-Mirim, western region of the State of Rondônia. Thus, when solid residues and tailings are thrown away, they also carry organic matter, which decomposes and turns into leachate. This material can contaminate both groundwater and the soil of downstream and upstream communities. Which according to Baird; Recio and Carreira [18] is constituted by volatile organic acids, heavy metals, salts of common inorganic ions and more common volatile organic compounds, being therefore very harmful to the environment and the health of the population [19]. The social impact of the garbage dump in Guajará-Mirim/RO is a place where 40 to 60 scavengers work daily and most of them arrive early in the morning and only return in the early evening. The scenario is in an area where currently several collectors make their living by selling recycled materials.

II. METHOD

The research tool used was the UCINET Software tool ar
NetDraw, where data from social networks are analyzed.

The tabulated data were entered into social network analysis software Ucinet and Netdraw, for quantitative analysis and visualization of the main parameters of the network [20]; [21];. The field study, of an exploratory nature, through systematic observation with on-site visit, was carried out from February to March and July to August 2019. A questionnaire was applied to solid waste collectors in the city of Guajará-Mirim / RO (scavengers who work daily at the Guajará-Mirim landfill and collectors who work in the city collecting, mainly in residential dumps); the small business collectors and the Reciclagem Paraíso warehouse manager. After carrying out the data collection, the Ucinet and Netdraw tool was applied to describe and analyze the scenarios of the production chain in the solid waste sector in Guajará-Mirim.

III. ANALYSIS AND DISCUSSION OF LIMITS AND POSSIBILITIES AT THE LOCAL LEVEL

3.1 ECONOMIC AND SOCIO-ENVIRONMENTAL SCENARIO OF THE RECYCLING ACTIVITY IN THE MUNICIPALITY OF GUAJARÁ-MIRIM

To characterize, the results are presented below using the UCINET and NetDraw tools. Alejandro and Norman [22], they claim that social network analysis is a tool that allows us to know the interactions between any class of individuals, starting from qualitative and not quantitative data. However, it is worth noting that the analysis process followed in loco in five stages: 1st At the open-air dump in Guajará-Mirim; 2º In the urban area of Guajará-Mirim with the scavengers who collect waste from residential dumps (door-to-door collection); 3rd With the manager of the Association of Solid Waste Collectors (ASCANOV); 4th Small merchants who buy these recyclable materials; 5th With the manager of the recycling warehouse Paraíso, a waste recycling company from Guajará-Mirim.

In the city of Guajará-Mirim, according to IBGE data on the disposal of solid waste, (65.18%) is collected directly by a solid waste cleaning service, (14.37%), placed in a cleaning service bucket, (17.65%) are burned on the property, (0.91%) are buried in the backyard, (1.89%) are given other destinations. On average, 10,502 kg of solid waste are collected daily, as shown in table 1.

Table 1 - Final disposal of waste in the city of Guajará-Mirim/RO.

Final Waste Destination – 2010	
Collected directly by cleaning service	6964 kg

Placed in cleaning service bucket	1535 kg
Burned (on property)	1886 kg
Buried (on property)	97 kg
another destination	20 kg

Source: IBGE data. Elaboration by the authors.

3.1.1 Organizational Structure of Solid Waste Collection in the city of Guajará-Mirim/RO.

As defined by the Brazilian Association of Technical Standards (ABNT) [13], urban solid waste is solid and semi-solid waste resulting from community activities of industrial, domestic, hospital, commercial, agricultural, services and sweeping (NBR 10004/2004) [13]. The solid waste segment has been growing and gaining importance for the economic sector, where several families earn their income through the collection of this waste. The municipality of Guajará-Mirim has an association of solid waste collectors with the name Nova Vida Recyclable Product Collectors Association (ASCANOV), but without physical structure, in which it is currently abandoned. The municipality has shown capacity in collecting this material, according to information from the Reciclagem Paraíso deposit manager. 45 to 54 thousand tons are recycled per month (including plastics, cardboard, aluminum and copper). In this way, Guajará-Mirim, with the number of inhabitants, produces an average of more than 41,000 kg daily. Productivity is low, only 3.33% are recycled.

In the city of Guajará-Mirim/RO, there are approximately 10 small businesses that buy waste directly from collectors. We can classify scavengers into two categories: those who work only in the city and others directly in the open dump. The open-air dump is 6 km from BR 425, rural area of the municipality, as shown in figure 1.

Fig.1- Photo of the dump in the city of Guajará-Mirim/RO.

Source: Google Maps [23].

The production chain of recyclable materials in the city of Guajará-Mirim is made up of three main segments: supply chain (pickers and small businesses), main chain (recycling warehouse) and auxiliary chain (transport). In the first segment are the links referring to: (1) collection and sorting - scavengers look for materials where they occur (dumps and home dumps), separate them in the way that best suits small businesses and the warehouse to sell them. Small businesses, after having a certain amount of materials, go to the recycling warehouse to sell. The existing partnership of small businesses with the warehouse is in the provision of transport, which is provided free of charge; (2) block compaction processing - the process that prepares solid waste for transport, in the recycling warehouse using the press machine, to facilitate transport, organize and to reduce the volume.; (3) transport of recyclable materials to the city of Campo Grande/Mato Grosso do Sul. When society uses the separation of waste, it starts to play an important role in this chain as it begins to dispose of it in an orderly manner, facilitating the work

of the collector.

In Guajará-Mirim, it is possible to identify in the context of this chain a productive agglomeration in which agents involved in the collection, sorting, marketing and transport of urban solid waste participate. It is necessary for the public authorities to create public policies to strengthen this agglomeration so that a solid waste productive arrangement can be consolidated, which can work and promote the principles of economic development and social and environmental responsibility. The development and strengthening of this solid waste segment in Guajará-Mirim will allow for an increase in the productivity of the productive agents involved, in addition to the sustainability of the inclusion of collectors and environmental management, reducing environmental risks and offering minimal working conditions.

3.1.2 Labor Involved and Personnel Occupied with the activity of Collecting Recyclable Materials.

The collection of solid waste from the city of Guajará-Mirim/RO, 90% of which comes particularly from homes, and this collection is carried out by scavengers.According to information from the manager / owner of the Paraíso Reciclagem depository, it is estimated that 120 (one hundred and twenty) people work with this type of service (Personal Communication).

The materials collected in Guajará-Mirim/RO, initially, are limited mainly to household waste, to Civil Construction waste, such as aluminum, which is the second largest in quantity recycled in the municipality. In addition to the environmental impacts of solid waste, there are social impacts related to the activity of these collectors. The solid waste chain houses a large number of formal and informal workers, from employees of the Paraíso recycling company, involved in separation, processing and transport, to collectors and their families, who live exclusively from solid waste collection. Primary employment for the maintenance and support of a family, however, needs certain conditions to be met. With the creation of the Local Productive Arrangement, it will influence the positive scenario on the social issue of solid waste processing, ranging from social inclusion to the rights and benefits available to urban workers.

Currently, the sustainable vision is for there to be more environmental education in society, thereby generating a reduction in solid waste. At first, environmental education can already be worked on, so that there is awareness in the separation of solid waste into “dry” and “wet” ones, to facilitate collection by this segment. One of the lines of thought being worked on is for recycling, reuse and disposal or final destination in a way that is correct for the environment.

3.2 ASSOCIATION OF RECYCLABLE PRODUCTS COLLECTORS NOVA VIDA (ASCANOV).

The Nova Vida association (ASCANOV) was created on July 31, 2008, and was formed by recycling collectors in the city of Guajará-Mirim/RO, located at Avenida Pentecostal, 3875, Bairro Jardim das Esmeraldas. The Nova Vida association is a legally constituted entity, and has CNPJ, Corporate Name, statute of partners and the declaration of the Federal Revenue every year, they are made. It was created with the objective of promoting the integration of the public and private sector to make viable actions, projects and partnerships that represent the micro and small businessmen who work in the segment of collection, transport and disposal of solid waste in the city of Guajará-Mirim.

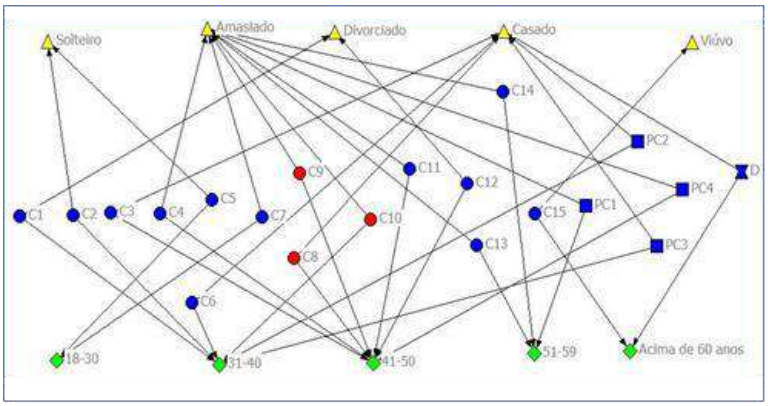
ASCANOV is currently managed by President Cibele Landivar, daughter of former President Rolando Landivar Arauz (in memoriam). According to the president, “the association has presented many difficulties, mainly because it does not have a headquarters and a shed, but that was not enough to end it. The association's board of directors is made up of 10 partners and 33 scavengers are members of the association. The monthly fee charged is R$ 10.00 per month, which are covered to pay for the association's documentation. They have membership cards to identify that they are scavengers. However, the solid waste collection activity in the city by these collectors precedes the creation of the association of collectors.

3.2.1 Personal Data

Graph 1 deals with the population consulted regarding gender, age and marital status. The research is composed of 20 people divided into: 15 (fifteen) collectors (C) with 80% male and 20% female results, and 4 (four) micro-entrepreneurs (PC), all managed by men and in the company Paradise Recycling (D) being also administered by men. The dots in red (C8, C9 and C10) are women. Regarding the age group, it can be seen that the people who work most with recycling are in the range of 31 to 50 years old. From 18 to 30 years old (10%), 31 to 40 years old (30%), 41 to 50 years old (35%), 51 to 59 years old (15%) and over 60 years old (10%). It was observed that although most of the people consulted were over 30 years old, individual motivation, pride in the profession and there were no complaints about the activities carried out by solid waste collectors was verified.

The fifth premise was about marital status and the sample consulted resulted in 10% single, 45% have a partner, 30%

are married, 10% are divorced and 5% are widowed.



Graph 1- Gender, age and marital status.

Source: from the Research and prepared by the authors.

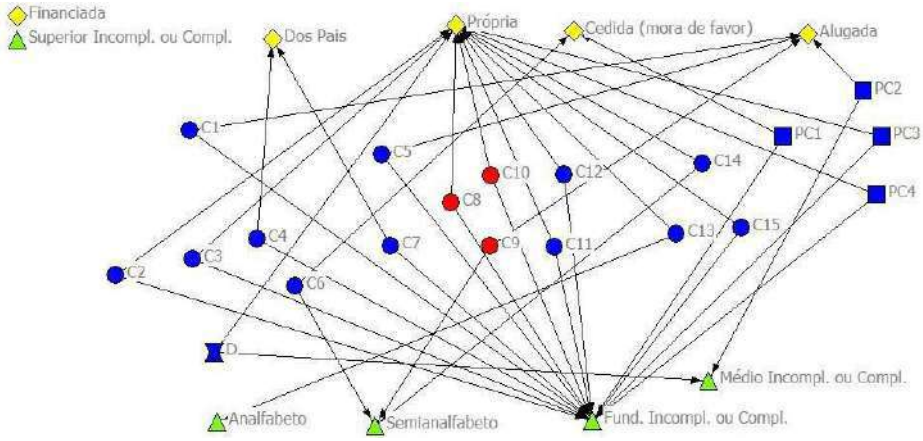
In relation to the premise "that deals with children", a total of 56 children was obtained: 5.36% are in the range of 0 to 5 years, 16.07% between 6 to 10 years, 11 to 18 (25%), above aged 18 years (51.79%) and only 1.79% did not have a child.

Table 2- Age range of children of actors in the solid waste sector.

	0 to 5 years	6 to 10 years	11 to 18 years old	Over 18 years old	Do not have children
C1	1	1	0	0	0
C2	0	2	1	0	0
C3	0	1	2	1	0
C4	0	1	1	1	0
C5	1	1	0	0	0
C6	0	1	2	*0*	0
C7	0	0	0	0	1
C8	0	0	0	3	0
C9	0	0	1	0	0
C10	1	1	2	0	0
C11	0	1	0	1	0
C12	0	0	2	2	0
C13	0	0	0	2	0
C14	0	0	0	4	0
C15	0	0	0	2	0
PC1	0	0	0	4	0
PC2	0	0	2	1	0
PC3	0	0	1	1	0
PC4	0	0	0	4	0
D	0	0	0	3	0
Total	3	9	14	29	1

Source: From the research and elaborated by the authors.

In Graph 2, it deals with the assumptions about the level of education and housing. The educational level of the respondents, for the most part, is low, (5%) illiterate, (15%) semi-literate, (70%) incomplete or complete elementary school, (10%) with incomplete or complete high school, (0%) in incomplete or complete higher education. In total, 90% are in the range between illiteracy and elementary school. Despite the low level of education, they develop a very quick calculation ability. As for housing, (60%) have their own house, (10%) the house belongs to the parents, (20%) is rented, (10%) is given "a favor house", and No house is financed. Even though most of them have their own residence, the predominant characteristics are wooden houses, wooden fences, bathroom "black pit", those installed in the backyard. Only 30% have a house built of masonry.



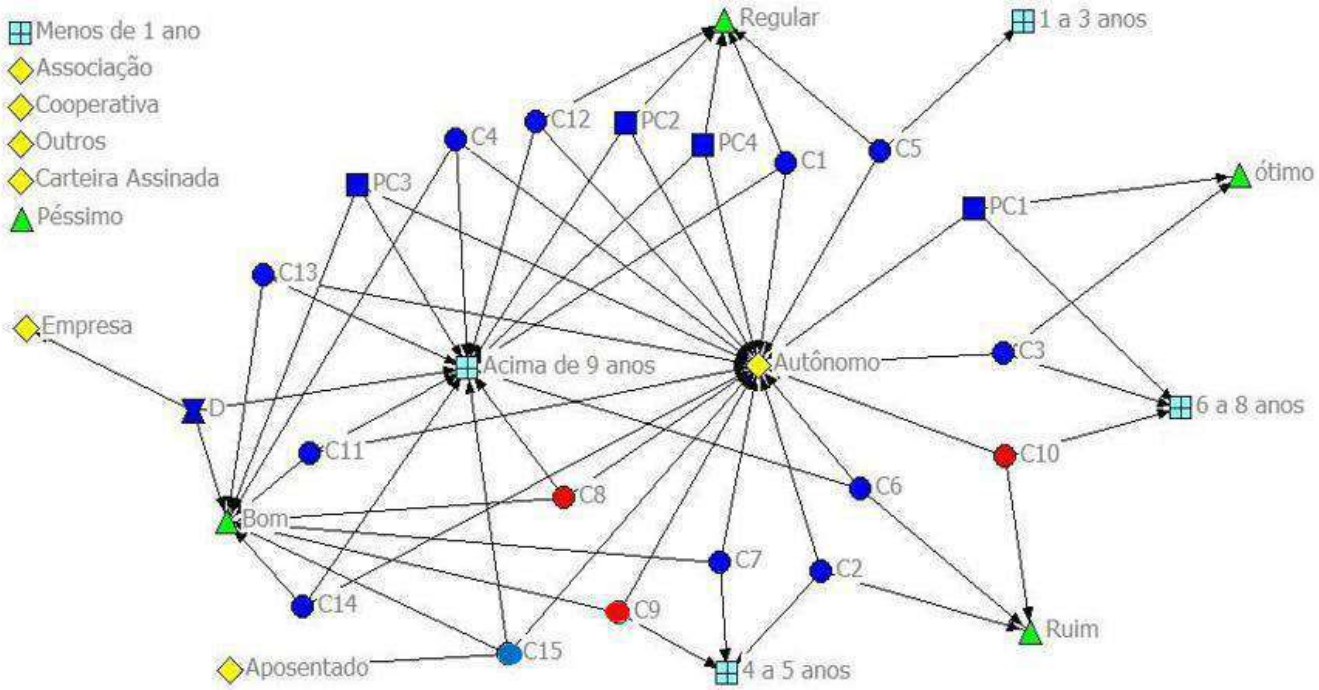
Graph 2- Level of education and the housing situation of actors in the solid waste sector.

Source: from the Research and prepared by the authors.

3.2.2 Professional Data

Graph 3 covers the following assumptions: length of experience in solid waste collection, workplace and employment relationship and reason for working in this activity in the solid waste sector. On the premise "How long have you been involved in collecting these recyclable materials?". It is observed that 80% of the actors have been involved in solid waste collection activity for over 5 years. None of them are less than 1 year old, 1 to 3 years old (5%), 4 to 5 years old (15%).

Next, it will deal with the place and forms of work, resulting in: (0%) have a relationship with the association of collectors, cooperatives and/or others, (95%) are self-employed, and of these, 5% are retired. As for the link with a company, only 5% are linked to this activity. The concept of self-employed was used as a person who works in the informal market with sporadic or daily work and without an employment relationship. Still in Graph 3, it dealt with "Relationships in the work environment". The result was: 0% very bad, 15% of them answered "bad", while 25% said "fair", with 50% saying "good" and only 10% excellent.

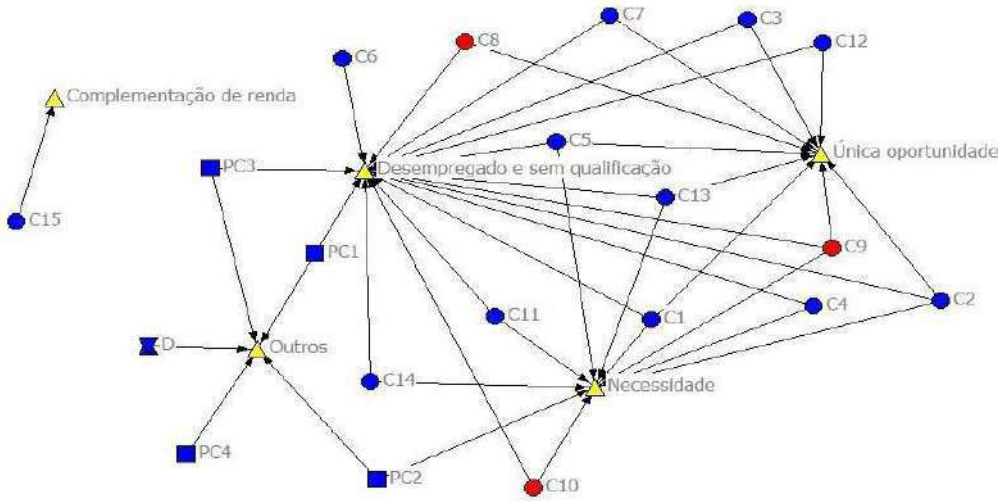


Graph 3- Employment bonds, length of experience and relationships in the work environment in the solid waste sector.

Source: from the Research and prepared by the authors.

3.3 ECONOMIC DATA AND THE ENVIRONMENTAL PERCEPTION OF THE ACTIVITY DEVELOPED

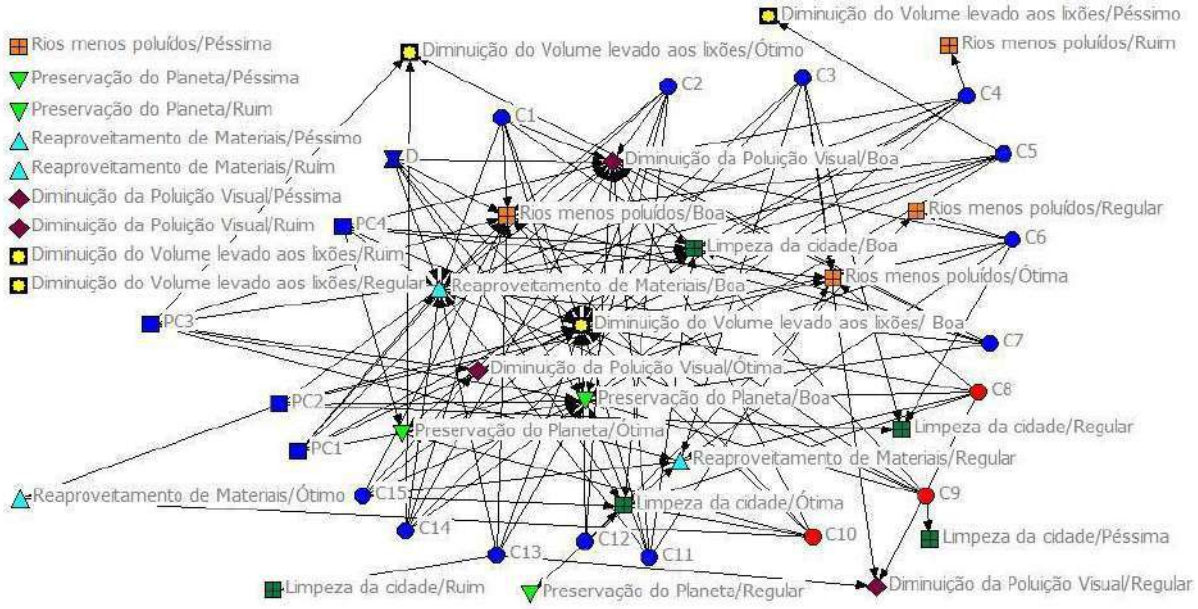
Regarding the main reason that led to working in the collection of recyclable materials, they answered more than one reason why they chose the activity: 80% said it was because they were unemployed and unqualified, at the same time 50% said it was out of necessity, and 45% said it would be their only opportunity, 5% as a supplement to their income and 25% for other reasons. The definition of others was specified as a way, according to them, as a way to earn money without leaving home. However, the situation that draws the most attention is the fact that these workers do not have a job guarantee, as they work in the informal market, being able to carry out daily activities that spread diseases, as well as being exposed to the sun and rain. The excess of hours worked and being overweight are part of the daily life of these workers. (Graph 4).



Graph 4 – Main reason for working in solid waste collection.

Source: from the Research and prepared by the authors.

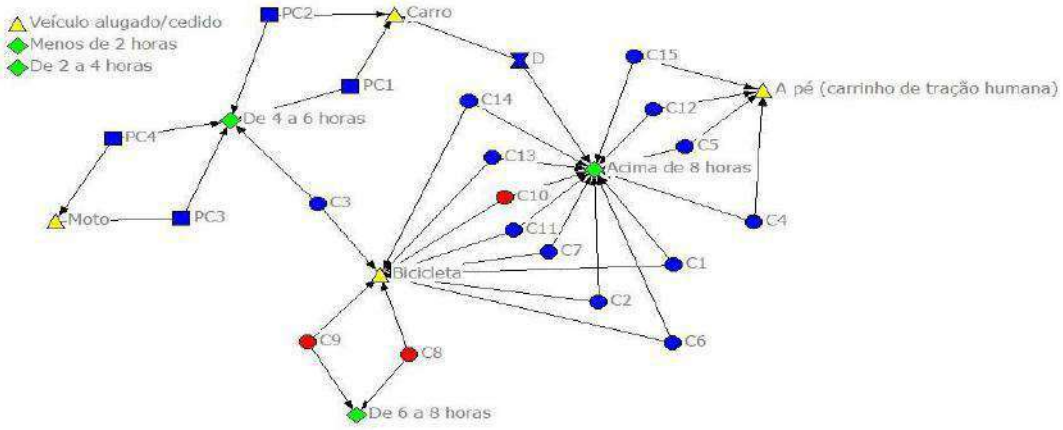
Regarding the perception of your opinion about the work activity, what is the contribution to: cleaning the city, 5% say "very bad", as their activity contributes very little to cleaning the city, 5% "bad", 15% “regular”, 45% “good” and 30% say they see it as a “great” contribution, as they reduce in addition to garbage in dumps, they still collect in urban areas. As for less polluted rivers: 0% said “very bad” that the activity does not contribute favorably, 5% “bad”, 10% “fair”, 60% “good” and 25% “excellent. Regarding the preservation of the planet: 0% "very bad" and 0% "bad", does not contribute at all, as the garbage collected is few in relation to the volume that is discarded daily, 5% "regular", 75% "good ” and 20% “great”, that the positive impact is satisfactory. Reuse of materials: 0% “very bad”, 0% “bad”, 30% “regular”, 60% “good” and 10% “excellent”. Despite seeing it as a positive, they do not have a work developed for the reuse of materials.Decrease in Visual Pollution: 0% “terrible”, 0% “bad”, 15% “regular”, 70% “good” and 15% “excellent”. Decrease in the volume taken to landfills: 0% “terrible”, 0% “bad”, 5% “regular”, 80% “good” and 15% “excellent”. It can be observed that the perception of environmental sustainability is seen as positive for most of them, as shown in (Graph 5).



Graph 5- Perception of the activity developed with environmental sustainability.

Source: from the Research and prepared by the authors.

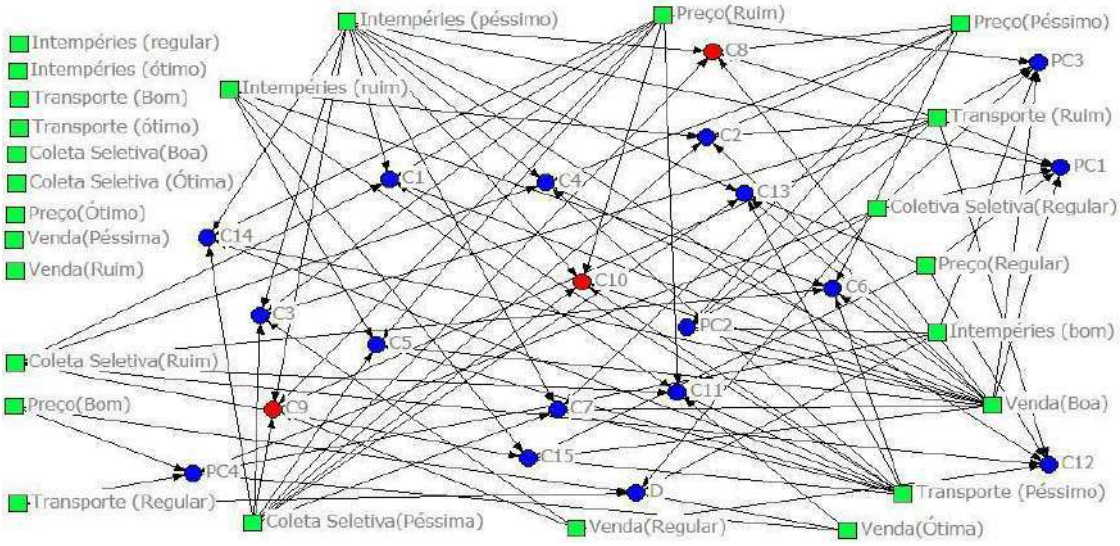
In this premise, he dealt with "What is the means used to collect recyclable materials": 55% of them use the “bicycle” as transport for collecting solid waste, 10% “motorcycle or scooter”, 15% “car” and 20% collect on foot (human-powered cart). Starting from the premise, it was asked “How many hours are worked per day? The result barely varied, prevailing 65% above “8 hours/daily”, 10% of “6 to 8 hours/daily”, 25% of “4 to 6 hours/daily” and 0% less than “two hours daily ” and from “2 to 4 hours”. (Graph 6).



Graph 6- Hours worked per day.

Source: from the Research and prepared by the authors.

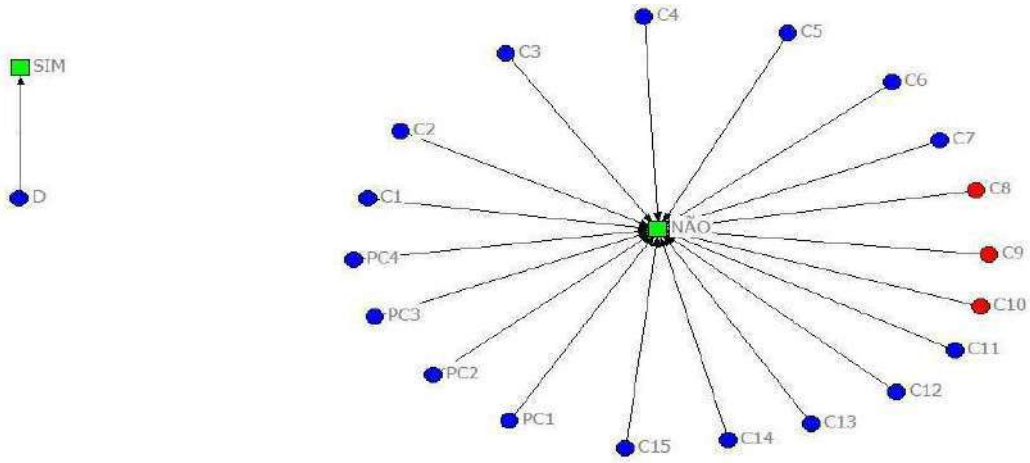
The main difficulties faced daily in the activity are presented in the form of the following assumptions: I- Weather, II- Transport (daily loading), III- Selective Collection in the City, IV-Price and V- Sale. It is worth noting that this activity is carried out daily and with hours worked in excess. One of the ways to facilitate the work of these waste pickers would be if there were selective collection and environmental education on the part of the population. As for the options: I- bad weather: 55% "terrible", 25% "very bad", 0% regular, 20% "good" and 0% "excellent". II- Transport (daily load): 45% "terrible", 40% "very bad", 10% regular, 5% "good" and 0% "great". III-Selective Collection in the City: 45% "terrible", 30% "bad", 25% regular, 0% "good" and 0% "excellent". IV-Price: 30% "terrible", 40% "very bad", 20% reasonable, 10% "good" and 0% "great". V- Sale: 0% "very bad", 0% "very bad", 15% fair, 70% "good" and 15% "excellent" (Graph 7).



Graph 7- The main difficulties faced daily by solid waste collectors.

Source: from the Research and prepared by the authors.

The use of personal protective equipment is almost absent: 95% said they do not use any personal protective equipment such as (gloves, masks, etc.), and only 5% use these. The only one who makes use of this equipment is the owner of the recycling warehouse with boots and gloves. It is a scenario that should be criticized and that deserves attention, as we can observe that, in addition to their daily dangers, at any time these workers can cut themselves with objects, in addition to the odor of slurry present in open dumps, as shown in (Graph 8).



Graph 8- Use of personal protective equipment.

Source: from the Research and prepared by the authors.

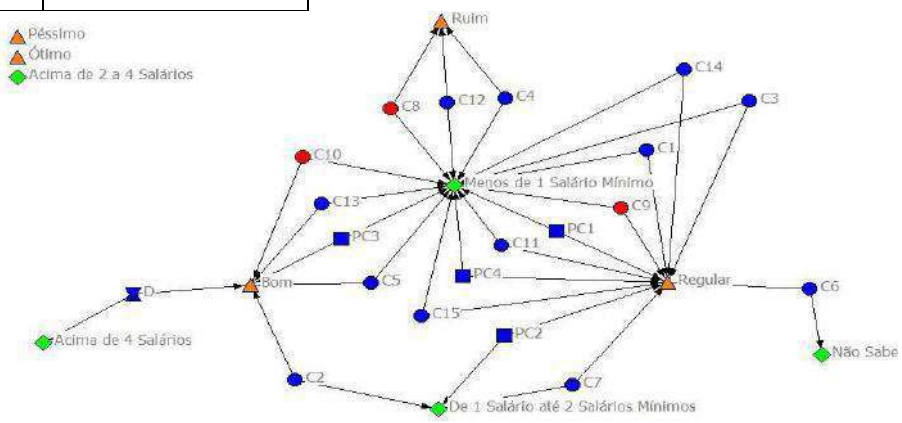
Every day, around 90 people go out to collect recyclable materials, men and women who use human-powered cars to carry out this work. It can be seen that no personal protective equipment is used by the worker (gloves, boots, mask, etc.). Regarding the main materials collected, the monthly average is around 40,000 kg, including: plastics (18,000 kg), aluminum (10,000 kg), cardboard (5,000 kg), copper (1,000 kg) and others (6,000 kg). The price list that the recycling deposit pays per kg corresponds to R$ 0.50 plastic, R$ 0.10 cardboard, R$ 2.00 aluminum and R$ 8.00 copper. Small businesses buy 20% to 30% cheaper than the recycling depot. (Table 3).

Table 3- Main materials collected/kg.

Material	Quantity/kg
Plastic	18.000kg
Aluminum	10.000kg
Cardboard	5.000kg
Copper	1.000kg
Others	6.000kg

Source: From the research and elaborated by the authors.

On this premise regarding the "monthly billing of recyclable materials": 75% receive less than 1 minimum wage, 15% from 1 to 2 minimum wages, 5% above 4 minimum wages and 5% don't know. The warehouse manager's revenue is around R$ 25,000 to R$ 30,000 reais (gross), deducting costs and expenses, net sales are between R$ 4,000.00 and R$ 5,000.00 (Graph 9). As for the premise that deals with "It considers the financial return to be sufficient to support or supplement the family income": (0%) terrible, 15% bad, 55% fair, 30% good and 0% said great. Despite the low profitability, most consider the support Regular (Graph 9).



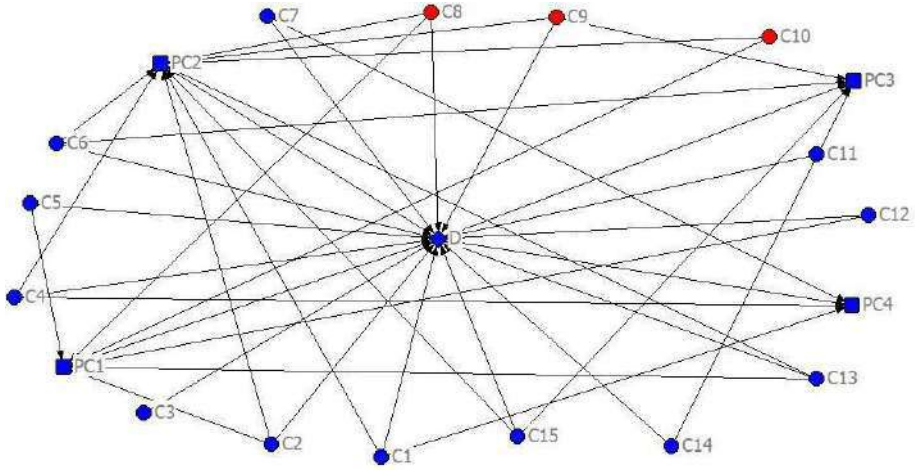
Graph 9- Monthly billing in the collection of recyclable materials.

Source: from the Research and prepared by the authors.

The company Reciclagem Paraíso, located in the city of Guajará-Mirim, was founded ten years ago. It currently has a staff of 6 employees plus two managers. The cost of transporting recyclable materials is outsourced, and the company that collects recyclable materials does it 3 times a month, on average from 15 to 18 tons, and the value of each ton is R$ 280.00. Freight is around R$ 4,200.00 to R$ 5,040.00 to the city of Campo Grande, Mato Grosso do Sul. The transport of recyclable material per month is around 45 to 54 tons.After purchase, the residues are separated and then pressed into blocks for transport to the city of Campo Grande, State of Mato Grosso do Sul. In the last five years, 1,500 (one thousand five hundred) tons were transported (Personal Communication).

When dealing with the premise "which partnerships exist with public and private institutions, recycling collectors and small recyclable material traders", they informed that there is no partnership. The institutions mentioned and remembered were: SEBRAE, SENAI, FIERO, Commercial Association of Guajará-Mirim, Universities and Research Centers, City Hall and City Council of Guajará-Mirim, schools, NGOs, Depósito Paulo Zeed (company responsible for collecting household waste), Association or Cooperative of Collectors, the Government of the State of Rondônia, State and Federal Deputies, or society in general.

The only existing partnership is between buyer versus collector. The warehouse manager goes to the small points of businesses that buy recycling, offering them free transport to the Paraíso recycling company. The commercial relationship takes place between collectors, small traders and the recycling warehouse manager, as shown in Graph 10. Every 15 days, the Paraíso recycling company also collects it directly from the dump, as agreed between the manager and the collectors.



Graph 10- Commercial relationship of collectors x small traders x manager of the Recycling deposit.

Source: from the Research and prepared by the authors.

3.4 CHALLENGES AND OPPORTUNITIES FOR COLLECTORS

The importance and potential of the solid waste segment in the city of Guajará-Mirim/RO is currently not organized. Several stakeholders could take part, such as: institutions from the productive, public, research and third sector. In a broader sense, these partners are part of a group of agents that have the capacity to strengthen and influence the behavior of local society and public and private institutions, aiming to consolidate environmental education for selective collection and economic sustainability for these collectors of solid waste.

At first, the proposal is to reactivate the headquarters of the ASCANOV association and build a shed to store the collected materials. With this it is possible to offer training, professional qualification, social inclusion and environmental education for environmental preservation.

3.4.1. Potential partnerships for the Solid Waste sector.

In the Productive Sector: Association of Solid Waste Collectors in the municipality of Guajará- Mirim/RO - ASCANOV; headquarters for training courses, meetings and storage of collected materials: Promote the generation of work and income through solid waste. Brazilian Micro and Small Business Support Service/ Sebrae-RO: Promote training courses for solid waste collectors with themes focused on strategic planning. National Service for Industrial Learning/Senai-RO: Offer courses and learning programs in different modalities for solid waste collectors.

In the Public Sector (Federal, State and Municipal): Ministry of Labor and Employment: Provide information on how to formalize solid waste collection activities through labor contributions. State Public Ministry:

Promote the inspection of solid waste disposal by the private company Depósito Paulo Zeed (DPZ), which is contracted to provide this service by the Municipality of Guajará-Mirim/RO. Municipal Health Department: Promote lectures on the conditions exposed by the activities developed, and influence the use of PPE (personal protection equipment). Municipal Secretariat for the Environment (SEMMA): Seek partnerships to create collection points in public and private institutions. Federal University of Rondônia (UNIR) and Federal Institute of Rondônia (IFRO): Integrate the Guajaramirense community, in a sustainable manner, with actors in the productive sector (solid waste collectors) and promote and support projects for this sector. Seek tools to ensure that goals are met and consolidate and strengthen your learning system, boosting its development and expansion.

3.4.2 Impact Mitigation Proposals

In order to propose measures to reduce the impacts on the open-air dump in Guajará-Mirim, some mitigating measures are mentioned, such as: For the soil, the best option would be the removal and transport of the mass of waste from the dump to a landfill, and the use of grasses to retain rainwater, reducing the speed of its surface runoff. For air quality, it would be necessary to direct the waste to the landfill and monitor the area to avoid burning the waste, and possible fire risks, due to the presence of biogas, in addition to encouraging environmental education practices. For a material from household waste to reach the recycling industry, there must be a collection and sorting system that guarantees that the material is recovered, meeting the quality and quantity criteria of the recycling processes. This sorting system, along the treatment chain, begins with the activity of consumers (separation at source), extending to other processes, such as the sorting that may take place in the association of ASCANOV collectors.

3.4.3 Recycling Proposals as Social Inclusion

The law on the National Solid Waste Policy reinforces the social bias of recycling with the participation of collectors, organized in associations and cooperatives. The partnership is the tool to be explored with this low-income workforce, which with this law, can be hired by municipalities without public bidding, becoming a priority criterion for accessing federal resources. The great challenge for Guajará-Mirim/RO is to mobilize the collectors, train and equip the association to play its important role. Four general strategies can be indicated so that recycling and the collector assume a more relevant space in the solid waste management system, considering that the expansion of the collector's role in the recycling production chain will greatly contribute to the efficiency of the entire system. The first strategy is to include them as selective collection service providers through the municipality of Guajará-Mirim, this inclusion will improve the productivity of sorting, increasing the quality of recyclable materials that reach the collectors. With that, it increases the quantity and improves the quality of the raw material to be recycled. A second strategy is to invest in equipping the association of collectors, but the economic viability of such investments, as well as access to resources, are a challenge. Thus, there will be capacity for the association to be contracted by the municipality for collection and recycling. The third strategy is the efficiency of collection and sorting, which can be enhanced with the participation of society, through the separation of solid waste, and with that these reach the association, increasing the quantity and quality of recycled raw material. Finally, the fourth strategy would be to add value to the materials separated by the pickers, the objective would be to increase the pickers' income.

Workers can be trained and qualified to expand production and economic increase. There are several challenges on the subject of solid waste, as it requires large investments, which requires creative solutions to not generate more waste of raw materials. The inclusion of collectors in the GIRSU (Integrated Management of Urban Solid Waste) system points out important strategies to deal with the external effects, the result of the production and consumption dynamics of the modern world, and in a contradictory way, at the same time, united through the inequality and the misery of the population.

IV. FINAL CONSIDERATIONS AND RECOMMENDATIONS

This work sought to establish preliminary comments on the environmental problems caused by the disposal of solid waste and to describe the impacts caused to the environment and society that can contract various diseases through the contamination of the water table by leachate.

Given this reality, this research verifies the need to build a landfill for final disposal of solid waste and to be implemented by the Municipality of Guajará-Mirim in the State of Rondônia. An efficient way to alleviate the problem is the construction of a landfill whose impacts on the environment with its implementation are small and easy to control, compared to the benefits it is able to provide to municipalities that invest in this type of system. Landfill is an attractive and lower-cost method for communities with few financial and human resources, and which can satisfy the conditions for preserving the environment.

Currently, collectors in Guajará-Mirim/RO are inserted in an informal collection scenario and in the selection of recyclable materials. This condition demonstrates its unfavorable position in the link of the production chain, with the lowest economic revenue. The collectors' recyclable material collection system has three main limitations: 1) low remuneration; 2) lack of technology and 3) lack of public awareness of selective collection.

There is a need for continuous monitoring of the soil, surface and subsurface water of the aforementioned dump in Guajará-Mirim/RO, as it is a potential source of contamination. There is a need to analyze the water of the streams, especially those close to the dump. It was not possible to carry out the physical, chemical and biological analysis and the lack of it did not allow us to establish a precise link regarding the quality of soil and water.

Thus, it is essential to consider carrying out inspections under the legal aspect of the matter, but for that an investigation is necessary that offers an answer to the whole society and that the Public Power can comply with the legislation of the National Policy on Solid Waste. It is hoped that this work can contribute to local public policies and as a source of research for other works.

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Sustainability Indicators and Indices in Mining: A Critical Approach

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***Abstract*—** *This study aims to deepen the discussion on sustainability mining using existing indices and indicators, and investigate the development of indices and indicators specifically for Brazil. This research is driven by the need to measure and understand sustainability in mining, and to derive solutions and alternatives for minimizing adverse impacts. An exhaustive literature review of international peer-reviewed academic articles published over the past 47 years was performed. An overview of the relevant literature was developed via a bibliometric approach, using VOSviewer. Incomplete areas, related to building a mining index structure that is able to measure and understand the sustainability of mining and enterprise management, were observed. We found that it is unnecessary to develop other sustainability indicators for mining, since the existing indicators are abundant, comprehensive and flexible for application in different regions and mineral substances. However, we still need to develop new sustainability indices that can assess this issue.*

I. INTRODUCTION

Mineral assets are essential to human life (SHEN et al., 2015; PEDROSA BATISTA et al., 2019; GOKHBERG et al., 2020). Mining is the foundation in the production chain of popular industrialized products. Mineral production plays an important role in several segments of the Brazilian industrial sector. According to the National Mining Agency (ANM) (ANM, 2019), there was a 15.4% growth in mineral production in the first half of 2019, compared to 2018. This growth represented 20.8% of national exports of the mineral extractive industry during the discussed period. According to the Ministry of Mines and Energy (MME) (MME, 2020), Brazil extracts about 80 minerals used in various production chains in more than 2,300 municipalities. Mineral products are crucial for various industries, including automotive vehicles, civil construction, furniture, and electronics. Yellishetty et al. (2008), Zhao et al. (2014), Delgado et al. (2019), Silva et al. (2019), Expósito and Velasco (2020), Kozlowski and Mackiewicz-Talarczyk (2020), Ferreira et al. (2020), Shershneva et al. (2020), He et al. (2020) and Dias et al. (2020), state that production chains of various industries such as agriculture (fertilizers, soil correctives and remineralizers), food (input for food processing), electro-electronics, data generation and transmission, energy production and transmission, etc., require mineral substances.

Conversely, mineral substances have the potential to cause serious environmental, social and economic degradation (JONES et al. 2017; SRIVASTAVA et al.,

2020), posing challenges to sustainable development (AZAPAGIC, 2004). Local and occasional regional impacts include topographic modification, altered geological, geomorphological and hydrological conditions, vegetation and soil removal, and changes in fauna habitat. These impacts can lead to dust emissions, effluent discharge, noise, visual pollution, increased traffic volume, and significant amounts of waste material that affect water resources worldwide (WORRAL et al., 2009; DE MACÊDO COELHO et al., 2020).

Sustainability in mining emerges from the apparent paradox of reconciling the perspective of intergenerational guarantees (WCED, 1987) and the consumption of a finite resource. Worster (2016) questioned the prevailing vision of a world endowed with infinite natural resources and the ability to support an exponentially growing population. "We are no longer a small world on a big planet. Now we are a big world on a small planet, on which we have reached a saturation point" (ROCKSTRÖM, 2016, p. 4). Despite this new perception about the limits of regeneration of natural resources, the intuitive association between development and environmental degradation prevails. An antagonistic relationship between economic growth and environmental preservation, remains a challenge to be overcome (LAMBERTINI, 2016). Thus, the concept of "sustainable mining" requires adjustments that reflect the epistemological basis of sustainable development. The sustainability indices and indicators have significantly contributed in analyzing the activities that impact natural resources (CARVALHO et al., 2011). These indicators facilitate data gathering, data quantification, and decision making, which highlight their importance (VAN BELLEN, 2005; SILVA et al., 2010).

Azapagic (2004), Singh et al. (2007), Silva (2014), Shen et al. (2015), Aroudo Mota et al. (2017), and Dialga (2018), have developed sustainability indices and indicators for mineral substances. However, such indices and indicators (Viana, 2012; Long et al., 2016; Bui et al., 2017) found in the literature primarily focus on the business management of large enterprises and specific mineral substances. Thus, characteristics of mining activities, including clandestine activities, are often overlooked. Identifying the sustainability of the activity, regardless of the mineral substance, location, size of the enterprise, and operations licensing is crucial, since these factors significantly impact the socioeconomic and environmental spheres.

We aimed to conduct a literature review on indicators and sustainability indices for mining. Brazil is a region that specifically lacks studies on the development of such indices and indicators. Almost all existing research is conducted and aimed at international mining, and proposed for specific contexts. Therefore, such activities have particular characteristics that differ from the Brazilian reality, attributed to parameters that lack available or obtainable data. This paper reviews and critically analyzes the literature to answer the following Research Questions:

QP1: Do existing sustainability indices and indicators accurately reflect the sustainability of mining in Brazil?

QP2: Is developing new sustainability indices and indicators for assessing mining in Brazil necessary?

II. MATERIALS AND METHOD

A temporal limit was established, addressing the literature published over the past 47 years (the first articles identified with the research approach), from 1973 to 2020. This literature review was guided mainly by academic search engines that encompass large research databases such as ScienceDirect (Elsevier), Scopus (Elsevier), SpringerLink (Springer), SciELO.ORG, and Google Scholar.

The nomenclatures were defined according to identical terms and searched in the context of sustainability in mining, for finding the largest number of relevant documents. Peer-reviewed articles were sought, written, and classified in Portuguese and English, according to the criteria presented in Fig. 1. It is noteworthy that the secondary references were consulted in order to identify if any research developed indexes and indicators with the objectives of this research. As these references addressed another focus, they were not accounted for in the bibliometry.

Several publications focused on approaches that are beyond the scope of this research. Several publications on sustainability in engineering and corporations, the ecological footprint of renewable resources, and Life Cycle Assessment (LCA) of materials, were discovered. A set of references was automatically discarded based on their title and abstract, as they addressed challenges that were irrelevant to mining (e.g. "data mining" and "text mining"). Articles deemed “relevant” are decided based on the subjective authors' criteria; hence, unintentional omission of important publications is possible. However, the authors have endeavored to consider most of the topics and case study examples related to sustainability, and the use and development of indices and indicators in mining.

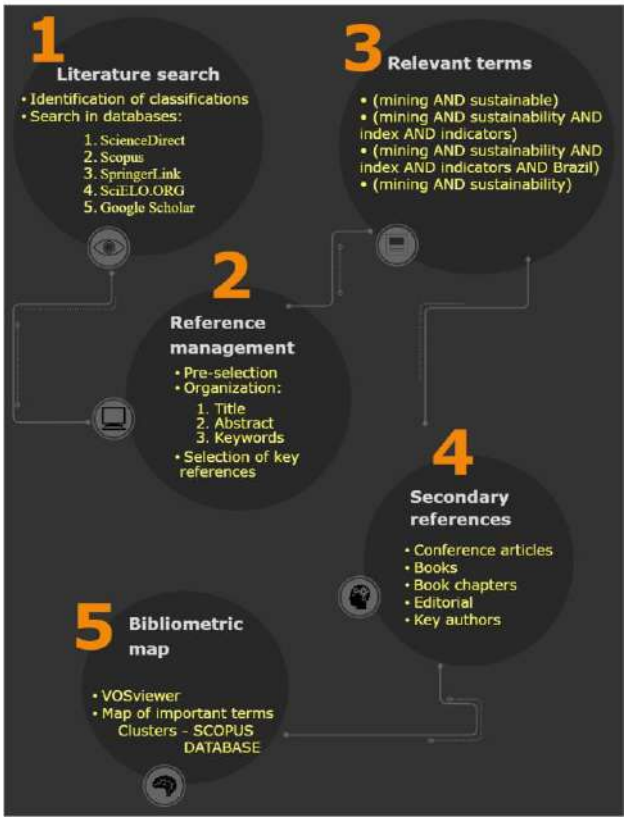

Fig. 1: Flowchart with the defined criteria.

The Scopus database was explored to conduct a detailed metric search on the proposition of sustainability indices and indicators for mining, in existing research. The Scopus database is considered comprehensive, relevant, contains the world's largest database of abstracts and citations of peer-reviewed literature, and uses bibliometric tools to track, analyze and visualize the research (DE OLIVEIRA and GRÁCIO, 2012; SCHOTTEN et al., 2017; SANTOS and XAVIER, 2018). Thus, the other databases, Science Direct, Springer, Scielo.ORG and Google Scholar were only consulted for purpose of finding research with the focus of this unidentified article in Scopus.

Finally, we used VOSviewer, a software application developed by Van Eck and Waltman (2010), for constructing and viewing bibliometric maps. It was applied to facilitate the visualization of the terms most cited by the documents researched in mining sustainability, and a map of keywords was built based on co-occurrence data provided by Scopus. VOSviewer only used this database because it facilitates the application of precise bibliometric techniques. The map generated provides color-based term density clusters, ranging from red, yellow, green to blue, respectively, indicating the highest citation frequency of these terms and their importance.

III. THEORETICALS STUDIES

3.1 Sustainability Indices and Indicators

In the 1970s and 1980s, indices and indicators were imported from the economic to the environmental sphere by governments and international organizations, to disseminate information on environmental conditions (FRANCA, 2001). In the 1990s, there was a considerable increase in the search for such indices and indicators, especially by governmental and non-governmental organizations, research institutes and universities. However, the theme was relatively new to the academic community. The concepts, experiments, and research results were recent, and most were developing. Consequently, the search for indices and indicators became unreliable due to the lack of quantitative assessment methodologies and the limited availability of environmental statistical data (MARZALL and ALMEIDA, 2000; MIKHAILOVA, 2004).

The use of environmental indicators increased in the 2000s. Thus, indicators were used to inform the progress of a certain goal, such as sustainable development. Moreover, the use of such resources facilitates easy perceptibility of a trend or phenomenon (HAMMOND et al., 1995; VAN BELLEN, 2005). Santos (2004) states that an indicator facilitates identification of reality through a set of data that represents parameters capable of demonstrating the environmental conditions. Thus, sustainability indicators structure information on key points and trends for sustainable development. Controlling the changes in the sustainability dimensions is possible using the information provided by such indicators (VAN BELLEN, 2004; RAMETSTEINER et al., 2011). Therefore, the indicators are fundamental for decision-making, especially when compared to other methods of obtaining information (GALLOPÍN, 1996).

A sustainability index is generated from a set of indicators, mathematically synthesizing a series of quantitative and/or qualitative data associated with sustainable development. Each index generates a numerical value resulting from the mathematical operations, combined with the input information. This value is then analyzed by comparing with a standard scale, facilitating sustainability evaluation (MARZALL and ALMEIDA 2000; SICHE et al., 2007; KRONEMBERGER et al., 2008; VIEIRA and STUDART, 2009). Some authors such as Veiga (2010), Da Cunha Kemerich et al. (2014), Froehlich (2014), Barros and Barden (2019) and Ottoni et al. (2020) classify these indices as sustainability indicators. However, Van Bellen (2004) assumes that indices represent a higher level of aggregation of indicators. Thus, few references use the

terms "indicator" and "index" appropriately (GOMES et al., 2000; SICHE et al., 2007).

However, the indices and indicators should not be considered as solutions for all sustainability challenges (FERNANDES, 2004). Sustainability indices and indicators are useful in evaluating performance in the three sustainability dimensions (SHIELDS et al., 2002; SALDANHA, 2007). It is essential to observe the weaknesses and strengths of each indicator and index because these characteristics assist in choosing the most appropriate assessment parameter. To establish appropriate criteria of applicability, the indices and indicators must be built from existing problems. This allows for understanding critical aspects and obtaining the true potential, based on established parameters (DA CUNHA KEMERICH et al., 2014; LEONETI et al., 2016).

3.2 Sustainability Indicators in Mining

National and several international initiatives regarding the development of sustainability indicators in mining currently exist. Agenda 21 and the Mineral Sector, Ethos Institute, Global Reporting Initiative (GRI), European Commission (EC), and Mining Association of Canada (MAC) are corporate examples. Azapagic (2004), Worrall et al. (2009), Viana (2012), Marnika et al. (2015), Yaylaci and Düzgün (2016), are a few relevant academic authors. However, the existing indicator proposals of these organizations and authors for the mining sector are predominantly restricted to the preparation of corporate sustainability reports.

3.2.1 Proposals and use of indicators in mining

Viana (2012) analyzed the indicators proposed by the corporate initiatives for the mining sector and his considerations are largely negative regarding mining sustainability. The indicators are limited because they address few topics relevant to sustainability and several regarding mining management. Thus, having as main focus the social communication actions - sustainability reports (VIANA, 2012). Some sets of indicators have been proposed by several researchers, for the same purpose as proposed by the corporate organizations. The 131 indicators developed by Azapagic (2004) are exclusively for evaluating large mining companies, since they have a large number of employees, high investments, and financial resources, and significantly impact the economy and socio-environmental factors. Azapagic (2004) listed the main issues to be addressed by indices and indicators in the mining sector classified into the following three categories: economic, environmental, and social problems (Table 1).

Table 1: Key sustainability issues for the mining and minerals sector.

Economic problems	**Environmental problems**	**Social problems**
Contribution to GDP and wealth creation	Loss of biodiversity	Bribery and corruption
Costs, sales and profits	Emissions to air	Job creation
Distribution of income and wealth	Energy use	Employee training and skills development
Investments (capital, employees, communities, pollution prevention, and mine closure)	Global warming and other environmental impacts	Equal opportunities and non-discrimination
Shareholder value	Nuisance	Health and safety
Added value	Toxicity of the product	Human rights and business ethics
	Resource use and availability	Labor/management relations
	Solid waste	Relationship with local communities
	Water use, effluents, and leachates (including acid mine drainage)	Stakeholder engagement
		Distribution of wealth

Source: Adapted from Azapagic (2004).

Chen et al. (2015) determined mining sustainability indicators based on the use of mineral substances in construction in Beijing, China. Marnika et al. (2015) proposed indicators based on activity parameters and mineral processing for environmental protection areas. In both these research, the sustainability dimensions were significantly imbalanced. Fekri Yazdi (2014) proposed a general framework to assess sustainability and focused specifically on steelmaking activities using few indicators.

Worral et al. (2009) developed sustainability indicators to particularly address the specific needs of areas abandoned after mining. Si et al. (2010) assessed environmental sustainability capacity in the coal mining industry. Thus the indicators used did not consider the three main pillars of sustainability. Yaylaci and Düzgün (2016) specifically evaluated indicators for coal mining. Bui et al. (2017) developed a framework restricted to the Asia-Pacific mining sector.

Regardless of the large number of indicators proposed and used by researchers and the corporate businesses in the mineral sector, most indicators are specific for certain regions and mineral substances such as coal and steel and intended for large enterprises. In addition, they are used disproportionately, by prioritizing one dimension of sustainability, inserting more indicators because of the reduction in other dimensions. Conversely, some studies proposed indicators out of sight. This increases the complexity of understanding the phenomena and consequently, corrupts the purpose of using indicators.

3.3 Sustainability Indices in Mining

A major challenge faced by the mining industry is ensuring minimal environmental impact, and the industry needs to adapt to sustainability to continue operation. To achieve sustainability, some indices have been developed to measure and evaluate sustainable performance and demonstrate continuous long-term improvement. Issues concerning business management, environmental performance, steel and steel industry, politics, economy and territory are specifically addressed in the development of mining indices (Fig. 2).

Long et al. (2016), Bui et al. (2017), Dialga (2018), Chen et al. (2020) and Angelakoglou and Gaidajis (2020) have recently proposed some indices for sustainability in mining. However, the number of proposed indices is observed to be lower than that of indicators, from the database searches. Therefore, the issues presented in Figure 2 were recent targets of extensive research for developing sustainability indices for mining. However, each index specifically addresses an aspect of mining.

Fig. 2: Schematic representation of the main topics addressed for proposing sustainability indices for mining. Adapted from the volume of the themes of studies published in the researched databases.

Thus, this section will be further divided into subsections to analyze and briefly describe the relationship of these issues with sustainability, using recent research.

3.3.1 Proposed mining indices

In this subsection, the main propositions of indices for mineral activity identified in the literature are addressed.

3.3.1.1 Economy, politics and territory

Bui et al. (2017) proposed the Indicator-Based Sustainability Assessment Framework (iSAF) to assess sustainability of the mining sector of Asia-Pacific Economic Cooperation (APEC) economies. The results suggested that iSAF is a suitable framework to prevent uncertainty and imprecision in economic decision making specifically for APEC, in relation to establishing the investments that would achieve sustainability. Dialga (2018) discusses the issue of sustainable development in countries with abundant natural resources, aiming to construct a Sustainability Index of Mining Countries (SIMC). The analysis indicated a lack of relationship between the values collected by states and their level of sustainable development. In addition, the number of indicators proposed (social - 5 and transversal - 2) for each dimension could be more balanced, to appropriately explain a phenomenon. In another study, Dialga (2019) establishes that the net impact of mining activity is difficult to measure. The tool most commonly used by companies subject to the requirement of Corporate Social Responsibility, is of the business group Global Reporting Initiative (GRI). This standard tool does not account for the specifics of the mining sector or the uniqueness of contexts. That is, addresses only managerial issues of enterprises and not issues that can make the performance

of sustainable activity, as indicated by Azapagic (2004). Hence, Dialga (2019) proposed the composite Mining Industry Sustainability Index (MISI) for policy making, to demonstrate the contribution of mining to the expansion of other economic sectors, the well-being of local communities, and management of environmental impacts. As a result, sensitivity and robustness analysis and correlation tests with other known indicators demonstrated the efficiency of the constructed index.

3.3.1.2 Steel and steelmaking

Long et al. (2016) highlights that there was no sustainable evaluation system designed specifically to meet the characteristics of the Chinese steel sector. The authors proposed the Sustainable Assessment (SA) system for helping Chinese steel companies in assessing their sustainability performance. The SA is based on the "triple-bottom-line" (the three pillars of sustainability - environmental, social and economic), however, the indicators used are specific to the steel industry. Singh et al. (2007) highlighted the difficulty in evaluating the performance of mining companies in the steel and iron segment based on a large number of sustainability indicators. The authors then developed composite indicators (which can integrate a large amount of information in simple formats) to assess the sector's sustainable performance from the proposition of the Composite Performance Index (CPI) for sustainability. According to Singh et al. (2007), the CPI allows the industry to identify opportunities for improvement and can be used in "benchmarking"; this is the process of searching for the best practices in a given industry, leading to superior performance.

3.3.1.3 Mineral business management

Viana (2012) conducted a nationwide study in which he measured mining sustainability by a management assessment system from the proposition of the Index of Mining Sustainability (ISM). The study concluded that a smaller quantity of indicators might be more appropriate to avoid repetition and irrelevance. Wang and Zhang (2018) conducted a study focused on coal enterprises in China, which aims for future healthy development, and establishing coal industries in a safe, efficient, and sustainable way is crucial. An index system based on Data Envelopment Analysis (DEA) was then developed to audit the progress of innovation and development of enterprises. The study resulted in twenty certified green coal mines, demonstrating success in the application and evaluation, to gauge the technological innovation of coal mines and improve safety, efficiency and sustainability. Despite the good index structure, it does not directly reflect the dimensions of sustainability.

3.3.1.4 Environmental performance

Silva (2014) hypothesized that open-pit mining has an environmental performance similar to other economic activities that are not considered detrimental to the environment. Therefore, the proposal of the Environmental Performance Index (EPI) for open pit mining aims to compare the environmental performance of other economic activities with that of mining. Silva (2014) established that even if the environmental performance of the mining company has been below the performance of soybean culture, it was not incomparable to the performance of agricultural activity. This contradicts the popular opinion that mining causes higher environmental impacts than other economic activities. However, the index is intended for comparing economic activities with environmental issues, and not addressing the dimensions of sustainability.

Chen et al. (2020) evaluated and improved the situation of green mine construction in China while suggesting a future framework. This is based on the Direction-Pressure-State-Impact-Response (DPSIR) model, which is regarded as the dimensions of the framework and establishes an evaluation index system. The index evaluated the construction of green mines and the results indicated that their performance has improved significantly over the years. However, there were still some unresolved problems, such as the recovery rate of ore processing and the reuse rate of coal washing water. Angelakoglou and Gaidajis (2020) designed a study for strengthening the ability of mining industries to evaluate and improve their environmental sustainability performance, by introducing an index framework. The application of the framework resulted in the construction of the Mining Industries Environmental Sustainability Assessment Index (I_{ESAMI}), which proved satisfactory, according to the authors. However, the proposed index only considers the environmental aspect of sustainability. All indices addressed aim to achieve sustainability in mining (Table 2); however, some indices emphasize the environmental issue, while others focus on the economy of the region of the enterprises, innovation or quality of business management. Thus, these indices have advantages and disadvantages in their application to assess sustainability in what they are proposed.

Table 2: Summary of the information of the most relevant sustainability indices for mining, proposed by authors identified in the research.

Index	Approach	Indicators	Advantages	Disadvantages	References
CPI	Steel and steel industry	75	Enables opportunities for improvement to be identified	Evaluates only steel industries and uses a large number of indicators	Singh et al. (2007)
ISM	Mineral business management	70	Assesses the level of sustainability of mining enterprises	Uses high number of indicators and complex evaluation	Viana (2012)
EPI	Environmental performance	2	Compares the environmental performance of other economic activities with minerals	Uses a very small number of indicators and poor assessment of sustainability	Silva (2014)
SA	Steel and steel industry	17	Helping Chinese steelmakers to identify sustainability performance	Assessment of the steel sector only	Long et al. (2016)
iSAF	Economic and territorial	20	Prevents uncertainty and imprecision in decision making	Analysis focused only on economics	Bui et al. (2017)
DEA	Mineral business management	19	Evaluates the capacity for mineral technological innovation	Assessment only of the economic context of coal undertakings	Wang and Zhang (2018)
SIMC	Economic, political and territorial	19	Uses more comprehensive indicators in the dimensions	Assesses sustainable development in countries with abundant natural resources	Dialga (2018)
MISI	Economic and political	18	Demonstrates the local contribution of mining to economic and socio-environmental aspects	Aims only at political and economic issues	Dialga (2019)
DPSIR	Environmental performance	20	Evaluates the construction of green mines and the sustainability of the mineral industry	Structure with a greater environmental focus in the construction of projects	Chen et al. (2020)
I_{ESAMI}	Environmental performance	108	Improve the environmental sustainability performance of mining companies	Assesses only the environmental aspect of the sustainability of the mineral industry	Angelakoglou and Gaidajis (2020)

Source: Prepared by the author.

Generally, the studies considering sustainability indices proposed for mining follow the same trend as the proposition of the indicators; they are developed for large-scale activities, specific regions, themes, or widely used mineral substances such as gold, copper, coal, and steel. Normally, these indices consider the most abundant minerals in their local region or their local economic value. For example, coal is one of the most commonly used primary energy sources, and its extraction and impacts are often targeted in sustainability criteria.

IV. DISCUSSIONS AND ANSWERS

4.1 Sustainability indicators and indices for Brazilian mining

National initiatives on sustainability indices and indicators for mining are at nascent stage. Viana (2012) and Agenda 21 and the Mineral Sector (MMA, 2004) were identified as Brazilian studies that have developed indicators. The authors of the present research hold a similar stance to that of Viana (2012): despite the existence of numerous indicators, several of these are not adapted to Brazil; thus, some issues remain overlooked.

The visual and noise impact caused by mining operations, the percentage of area occupied by facilities within Areas of Permanent Preservation (APPs), and the Financial Compensation for Exploitation of Mineral Resources (CFEM) are such issues. Others indicators are considered complex since their access is restricted to large corporate groups of mining companies as post-exhaustion economic alternatives and social decommissioning of the mine (VIANA, 2012). Of the indices researched and addressed, only the Environmental Performance Index for open pit mining (IDA), proposed by Silva (2014) and the ISM by Viana (2012), were developed and applied nationally. However, rare research for the use of indicators and indices in Brazilian mining lacks a set of measurement elements characteristic of the entire mining sector, focusing only on specific approaches and large corporate management.

Thus, it is understood that for QP1, the existing sustainability indicators, given their large number, scope, and flexibility in their application, reflect the possibility and feasibility of measuring the sustainability of mining in Brazil. However, the indices do not reflect this, since they are developed for certain themes and large enterprises, mineral substances, and specific regions, in addition to being composed of disproportionate indicators (in quantity, sometimes abundant, sometimes insignificant) in the dimensions of sustainability. In response to QP2, it is inferred that it is unnecessary to develop new sustainability indicators to assess mining in Brazil since there are a large number of existing indicators that possess the characteristics that allow for application in different regions. However, it is still necessary to develop indices that are capable of assessing the sustainability of Brazilian mining, because the existing international ones are directed to specific regions, with characteristics that diverge from those of Brazil, such as legislation, data availability, physical and socioeconomic aspects. Indices specifically constructed for Brazil also resulted in being very specific for certain elements, while overlooking others, making it unfeasible to apply the index.

4.2 Identification of classifications and search terms for indicators and sustainability indices in mining

A publication map can reveal the intellectual structure, thematic affinity groups and methodological emphases of an established context. This tool is based on criteria such as the occurrence of terms, study regions and bibliographic coupling of articles (CODATO, 2018). Fig. 3 shows the definition of the terms searched in the databases determined in this study. The quantitative values of the nomenclatures refer only to the data generated by Scopus. This data was used in the Vosviewer software to process and organize bibliometric information.

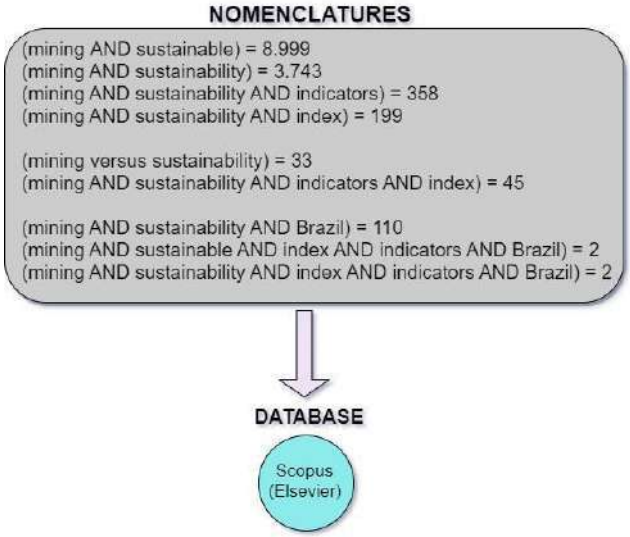

Fig. 3: Definition of the nomenclatures searched in the selected databases.

The identification of key terms in the context of mining comprised the period from 1973 to 2020. From the quantification of the occurrence of these terms in the knowledge areas of the Scopus database. Only the term "mining" does not provide the objectivity of the research, as it can arise in different contexts not connected to mineral activity. Fig. 4 shows a heat map of the terms identified in the documents collected by Scopus. In which, the hot colors (red and yellow) represent the keywords that are cited most frequently. The keywords "mining", "sustainability", "sustainable development", "heavy metals" and "data mining" formed regions in yellow connected to other terms called clusters. The clusters of the terms "data mining" and "text mining" do not comprise the scope of this work and are located in other areas of knowledge. While, the main cluster formed by terms "mining", "sustainability" and "sustainable development" contains expressions that indicate high correlation with sustainability in the mineral context.

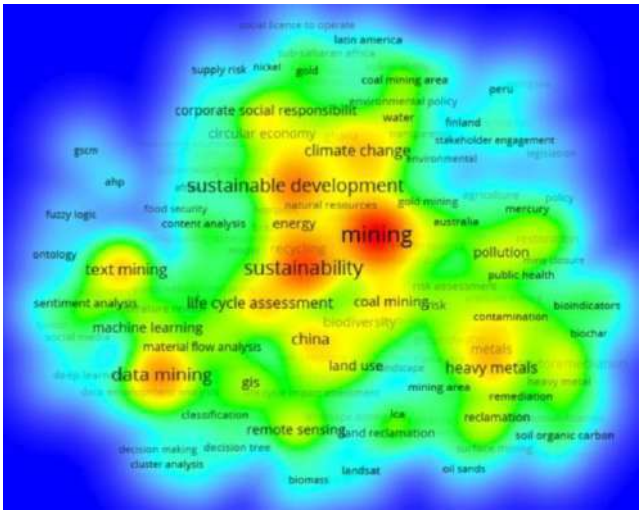

Fig. 4: Visualization of the co-occurrence network of terms from journals selected from the Scopus database (extracted from VOSviewer, May 2020).

The main cluster consists of terms addressed in the scenario of indicators and sustainability indices for mining shown in Fig. 2 of subsection 3.3. However, the absence of the terms "index" and "indicators" suggests that there is no correlation between the terms of this cluster present in the literature. Therefore, Fig. 4 shows the lack in the literature of studies that address indexes and sustainability indicators for the mineral sector, especially in Brazil.

V. FINAL CONSIDERATIONS

Based on studies that have developed indicators and sustainability indices for the mining industry, it is observed that the sector is progressing slowly in adapting its operations to sustainability. However, the high specificity of the indices restricts its applicability to large-scale mineral enterprises. Due to the absence of available data and the different physical, territorial, economic and socio-environmental characteristics, it is impossible to adapt indices for national application.

Most indices are composed of several indicators that prioritize the management of the main sectors (coal, steel and iron) in specific regions. Therefore, it is inferred that the existing indices fail to represent, as a whole, the sustainability of mineral activity. The use of indices and indicators in other regions and the diffusion between sectors contribute to the evaluation of sustainability in mineral activity.

The most used and relevant terms within the clusters (clusters) were identified and verified using bibliometric information generated by Scopus data. Thus, by increasing the specification of the search with the terms "index", "indicators" and "Brazil", only four articles were found. And, only one proposed the elaboration of index. What evidences the rare researches that address indicators and sustainability indices for brazilian mining.

Studies that develop specific sustainability indices and indicators or sustainability reports by mining companies are not discouraged to publish by this research. In fact, continuous generation of relevant information is necessary. Assessments of environmental impact and data transparency have to be intensified, considering the challenges and points raised by the discussed studies. Improvement is expected, given the continuous evolution of research aimed at achieving sustainability in mining.

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Public Policy for Urban Mobility and Port-City Relations

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***Abstract*—** *The objective was to discuss the interactions between the Harbour and the city. The method used was an exploratory, descriptive study of qualitative analysis through content analysis, and data were collected through secondary sources, with the use of normative and legislative documents of port operation and urban mobility projects, made available on the website of the Mauá Pier and the city of Porto Alegre. Finally, it considers that it is necessary to prioritize the speed of connections that carry the products and or services. And also, requires the development of local capabilities, they should interact with local or global dynamics from the perspective of sustainability, the port cities have a key role in the dynamics of the movement of goods and people, favouring intermodality, as meet global production chain processes driving the increased economic capacity and social interaction with the city and its extensions.*

I. INTRODUCTION

The global reorganization of productive spaces, occupation and circulation of goods and services in a dynamic system, started to demand synchronous and dynamic public policies, capable of tracing specific objectives and changes for the commercial viability of ports and cities, enabling mobility cargo, equipment, technology and labor. The study focuses on the interactions between the port and the city. Which shows a global scenario is favorable to this approach, as well as the need for a democratic project involving public and private forces in the reconstruction and revitalization of port communities, that is, those who live around the port and "live the port". The globalized world, at the beginning of the 21st century, requires agile and dynamic connections, as well as the appreciation of local potential and the relevance of attitudes towards issues involving the sustainability of natural, social, cultural and economic resources.

An important issue, especially in the areas of connection between the port and the city, is mobility, because when there are deficiencies in planning, management can lead to areas of conflict. The central port areas, then, need to be projected as a meeting point between the city and the port, establishing reciprocal valuation connections in the alignment of services and resources. For this to happen, it is essential to have public policies that provide the port-city relationship. The articulation of public policies is fundamental to commercial transit, in order to guarantee the systemic process of integration and circulation of people and goods, in order to achieve greater balance in the port-city integration. According to Monié and Silva [1]; Veltz [2], from the 1990s onwards there was an intensification of the process of economic internationalization and flow of goods and services, due to the growing integration of the spheres of production, consumption and circulation. The expansion of the port complex within the urban perimeter and the growth of the urban center in port cities created a scenario of potential conflicts between the needs of the port and the particularities and needs of the city, such as: a) the difficulty of intra-urban mobility; b) the intense traffic of trucks with cargo destined for the port; c) need for land for the use of container yards, warehouses, expansion of neighborhoods over rural areas; d) leisure and environmental preservation areas; and e) among other impacts and conflicts in the occupation and use of space.

That said, the problem at issue in this article is: How does the Porto Alegre port complex interfere with urban mobility in the city of Porto Alegre, RS? To partially answer the proposed question, the aim of this study is to analyze the port-city relationship (Porto de Porto Alegre in Porto Alegre - RS, Brazil). The specific objectives were: a) to describe the legal framework for the exploration of the Port of Porto Alegre; b) identify the port-city relationships based on this legal framework; and c) analyze the recent historical evolution of the functioning of the Port of Porto Alegre, as well as its surroundings (surroundings). It is proposed in this study to discuss and think about the city and its extensions, in order to guarantee the mobility of its inhabitants and the sustainability of its roads in the time now and in the future of the city.

1. 1 Urban mobility

According to Vaccari and Fanini [3], urban mobility is an attribute associated with people and economic actors in the urban environment who, in different ways, seek to meet and supply their displacement needs to carry out daily activities such as: work, education, health, leisure, culture, among others. To achieve these goals, individuals employ direct effort, resorting to non-motorized or motorized means of transport. It is essential, therefore, to understand that mobility in the context and way of life of contemporary cities and, particularly, of Brazilian cities constitutes a structuring part of the functioning of urban society. Thus, the rapid and intense transformation of the Brazilian population from predominantly rural to mostly urban in the 20th century, occurred from the exclusionary urban development model that concentrated on economic, territorial and demographic aspects (approximately 60% of the Brazilian urban population is concentrated in 224 municipalities with more than 100,000 inhabitants).

According to Lassave [4], knowledge of the practices and meanings of displacement in space and its determinants are, without a doubt, the most visible and durable axis of research in socioeconomic transport, and the central idea is mobility. The socioeconomic issue of transport can be understood as a phenomenon of mobility that is linked to the understanding of space and time as: a) in the Marxist perception: mobility is interpreted as an instrument for mobilizing labor; b) in the view of the Scandinavian School of Geography: mobility is perceived as an instrument for carrying out a program of activities located in space and time; c) from an economic point of view: mobility is perceived in terms of the way of life and the social division of space; d) in the understanding of sociology: it is understood by the feeling of the individual being subject to displacement.

In addition, Brazil has been living for some time, and especially since the second term of the Inácio "Lula" da Silva government, with a lack of articulation between the different public policies and also with a lack of alignment of these policies. The country had to get very close to logistical chaos, especially in large urban centers, for the

then-governors to launch the Growth Acceleration Program - PAC as an emergency measure to overcome the large deficit in infrastructure for the movement of people, goods and inputs. The same happened with the Minha Casa, Minha Vida Program - MCMV, also launched as an emergency to solve old bottlenecks in the national housing system and improve the living conditions of the low-income population. It is not very difficult to conclude that, in this case, the PAC-urban mobility must be strongly aligned with the MCMV, a fact that does not occur.

According to Brasil [5], (2005), the City Statute (Law n. 10,257, of July 10, 2001) regulates articles 182 and 183 of the Federal Constitution and establishes a set of guidelines and instruments for the implementation of urban policy. Aimed at ensuring the fulfillment of the social function of urban property and the fair distribution of the burdens and benefits of urbanization, the Statute, guided by the Brazilian Constitution, reaffirms the Master Plan as a basic instrument of urban development and expansion policy and defines that "property it fulfills its social function when it meets the fundamental requirements for ordering the city expressed in the Master Plan" (Law n. 10,257, of July 10, 2001, art. 39) [5]; [6].

In this case, the Institute for Applied Economic Research, warns of the lack of public policies for mass public transport, which adequately and satisfactorily serve the user and lead to greater urban mobility and beyond this deficiency [7]. What we have, at the moment, is transport with increasingly expensive tickets, and scrapped vehicles, often lacking adequate security. This causes a drop of about 30% in the use of public transport in Brazil in the last ten years. In some cities, depending on the route, it is cheaper to use a motorbike or car than the bus, subway or train. Not to mention cases where there is a total absence of public transport.

In light of this diagnosis, one of the ways the government found was to promote a set of potential public policies to improve mobility in Brazilian cities, but, however, it is clear that many of these policies are not aligned with other public policies social, economic and urban. Also, another purpose of the government in urban mobility issues is to discourage the use of individual transport, and this is due to concerns about the feasibility of using the roads for the amount of vehicle in circulation. There were two parallel concerns: a) the emission of gases into the atmosphere, thus affecting the environment; and b) education of the population for safer, more aware and sustainable traffic.

1.2 Public Policy on Urban Mobility

Public transport policy is so complex that, while the return is usually long-term, on the other hand it directly influences the population's quality of life and affects people's daily lives. Much of the assessment of municipal administrations is directly related to the performance of public managers in the area of transport. According to data from Ipea, the social importance of mobility has its repercussions on families where the family income maintainer receives an income of R$300 to R$400 monthly, the average mobility per inhabitant is 0, 5 or 0.6 trips per day, while in the income class above R$ 2,500, the average mobility per inhabitant reaches 2.4 trips per day. The proposals for a fiscal and tax policy regarding urban development are still deficient and precarious in Brazil, where the production of urban infrastructure has no tradition of private investment and the residential market is sharply restricted to luxury properties. Without public investment, economic growth is insufficient to promote social development and, therefore, to promote urban development [7].

In light of this, microeconomics is another relevant issue, as it is a property stimulated by different morphological understandings. Appropriate levels of micro economics demand and depend on structures that allow levels of supply of activities compatible with the density and number of its inhabitants. Considering the idea that the economic and social development of a country is measured by the speed and density of displacement of people, goods and services, the socioeconomic analysis suggests that the displacement of workers is more penalized by time than by spending on the family budget and, also, that transport or urban displacement arises as a consequence and cause of the city's growth and the spatial and temporal distribution of the activities, functions and services that constitute it.

The city is the space for mobility and displacement, but also for the permanence and inertia of the city. In cities, solidarity and coexistence are found, both mediated by the preexisting structure: harshness. Actions in cities are limited by the forms and norms of use of these preexisting structures, which does not prevent the presence of a cultural life that subverts their forms and norms. In theory, the city is a system that groups both a globalized economy, its superior circuit, and a popular economy, its inferior circuit, produced from the needs of the place [8].

It is important that managers know and understand their territory and seek to implement policies that can be effective, and efficiently. One of the fundamental policies for the "functioning of a territory" is mobility in the territory, be it of people, goods or services and communication, be it between the government and the community or between different actors in the community. Taking the urban mobility public policy as the focus of analysis, it can be said that it needs to be minimally aligned with the other public policies of the State (housing,

land use, education, production and distribution of food, transport and others) and that it can and should be evaluated on at least two variables, which are how much: infrastructure and management. As a result, on January 3, 2012, law 12,587 was enacted, establishing the guidelines of the National Policy on Urban Mobility, as an instrument of the Brazilian urban development policy, whose objective is to contribute to universal access to the city.

The reality of the issue of urban mobility, however, shows a double design: a) normative scenario; and b) a positive scenario. First, it seems evident, in Brazil, that the search for solutions, especially in the area of mobility, takes place in such a way as to disregard other sectors such as housing, sanitation, health and education, and also to consider actions that favor pedestrians the well-being of people and not the traffic of vehicles, showing a city with impacts on the health and safety of the population. Second, it is clear that the investments made still favor lanes for vehicles and lack of actions to promote pedestrian routes or alternative transport, therefore, it seems that they are failing to consider the hierarchy of importance established by Law 12587/12 [7].

Cities that meet the criteria of Law 12,587 (with more than 20,000 inhabitants) there is little interest on the part of municipal managers in seeking to develop a democratic plan that actually promotes the improvement of urban mobility in accordance with the interests of the population local. Another issue, which directly impacts the issue of urban mobility, is the relationship between infrastructure and the management of public actions in general. Infrastructure is related to the capacity of public facilities (roads, streets, ports, railways, waterways, airports, alleys, bicycle paths) and its relationship to demand. Management is related to the way in which these devices are operated. According to Lefebvre [9] and Santos [10], the lack of infrastructure in spaces, given the demand for public transport, for example, does not meet the needs of the population in their daily commute for various activities of daily life.

The relationship of integration between the different modes and the improvement of accessibility and mobility of people and cargo in the municipality's territory are the focuses of the new law (Law 12587). It aims to improve the planning and management of the country's urban mobility systems, prioritizing investments in non-motorized means and public transport. However, the irregularity of most conceptions of the city is in the way it deals with the connection “city - transport” or the meaning of “transport in the city”. According to Georges [11] it is because the city is not thought of as being “a system of movement” where it is difficult to deal with problems of urban displacement. The conception of the city as a movement system should consider the aspects: social, cultural, economic and environmental. These aspects should interact with each other and with the environment, impacting or not, depending on their public policies that provide evidence for a concern with the environment. Public policies associated with different aspects, deliberately or not, impact on the means of travel and, consequently, on the quality of life of citizens and on the survival of the natural city.

Management establishes dependence on infrastructure. There is no possible management to resolve a chronic infrastructure incapacity. In other words, there is no management to solve a daily traffic congestion in cities, in both directions of the road, which does not have an alternative road! Furthermore, when there is a lack of geographic space for this alternative route, it is difficult, if not impossible, to resolve the previous issue of local infrastructure. The inadequacy of management may have at its origins: a) legislation; b) institutional capacity; c) planning; d) implementation of strategic actions; e) interference by political actors; and f) patrimonial culture. All these origins, alone or in combination, can generate managerial dysfunctions that lead to a loss of focus on its effectiveness. In this way, they end up embodying disputes between bureaucratic and political poles, typical of “place management”. In this case, it is necessary to broaden the analysis focus and seek regional or global alternatives, and in this situation, urban mobility becomes a national issue and not just a local issue. This possibility will be disregarded in the present work, as the model to be proposed considers that the “chaotic environment” due to the deficient infrastructure is possible to be overcome with the increase of infrastructure capacity, either by physical expansion or by incorporating new ones.

In so-called democratic countries where there is an alternation of political groups in the government, where there is a technical framework capable of supporting the interests of the State against the interests of different governments, and where there is a quantity of mobility equipment that they may be considered sufficient, there may even be inadequate management, but, on the other hand, it is possible to think of a viable solution to pursue the ideal environment [12]. This situation can, as a result, be called an “inadequately managed environment”. The situation will be considered "ideal" when the volume of infrastructure is sufficient for present and future demand and the equipment management is adequate, for that historical moment and that particular region. That said, the “ideal solution” is dynamic and needs to keep up with the environmental changes surrounding urban mobility equipment.

1.3 The city and the dynamics of its relationships

The city and its socio-cultural relations can be considered strong symbolic references for the personal and community ordering of identities and histories, as a large part of the world population lives in urban contexts, sharing the perception of these sites with other social groups. In this sense, the city (real, imaginary or mnemonic) constituted a basic substrate of symbolic ordering for contemporary life, and can be perceived both by personal, individual biases, as well as by broader, community elaborations, built in the life plan: social, economic and political. Therefore, the analysis of the relationships between urban planning, mobility and belonging takes into account questions about the possible perception of the urban site by social groups that are part of it.

The way of life of populations is, however, affected by the organization of the urban site, and this fact is not always considered in city planning. Harvey [13] shows, for example, how the reconstruction of Paris, in the Second Empire, and Vienna, "fim-de-siécle", strongly influenced the modernist cultural and social movements and "... how important was the urban experience in the formation of the cultural dynamics of several modernist movements". Further on, the author works with the comparison between modernism and postmodernism in architecture and how the influences were different since "while modernists see space as something to be shaped for social purposes... postmodernists o they see it as an independent and autonomous thing" and, as a result, the objective of the latter is to pursue "aesthetic principles".

Therefore, it is considered that some characteristics of the organization and layout of cities influence both the daily practices of people moving (with or without motor vehicles) and their levels of sedentary lifestyle. There must be a community coexistence for the development of an ethical sense of social and environmental responsibility that can guarantee, for example, the option for public transport even for those who have private cars. Given this, it also requires, without a doubt, the guarantee of safety and quality to public transport. It is necessary that public transport is both efficient and effective, and is aimed at different audiences. The quality and safety of public transport can become the core of changing personal and social attitudes, as well as a new vision of the city for urban planners and managers.

For mobility to be sustainable, it is necessary to have two approaches: a) one related to the adequacy of the transport offer to the socio-economic context; and b) one related to environmental quality. The first includes measures that associate transport with urban development and social equity in relation to displacements, and the second includes the technology and mode of transport to be used.

Consequently, sustainable mobility, in the socioeconomic context of urban areas, can be seen through actions on land use and occupation and on transport management that aim to provide access to goods and services efficiently for all inhabitants, and, thus, maintaining or improving the quality of life of the current population without harming the future generation.

In this sense, some strategies can be considered to elaborate a Mobility Plan (PM) that meets criteria that allow for the well-being of the population and the sustainable use of the urban space and its surroundings. Are they: a) transport-oriented urban development; b) encouraging short-distance travel; c) restrictions on car use; d) the adequate provision of public transport; e) the collective transport tariff, adequate to the demand and supply of public transport; f) safety for pedestrians, cyclists and people with reduced mobility; and g) safety in public transport.

Part of these strategies is related to the form of urban occupation in which the following stand out: a) densification in the vicinity of public transport corridors and stations; b) the implementation of parking lots for integration with the public transport system; c) adaptation of sidewalks and implementation of routes for cyclists; and d) safety lanes and roads suitable for special people (such as sidewalks for the visually impaired, ramps for wheelchair users).

The emergence of water ports is, almost always, closely related to the occupation and settlement of its territory. The sequence of the historical evolution of the port-city relationship almost always involves the adequacy of natural conditions, and expansion, which normally makes both the city and the port grow due to the port activity, and the specialization, which is usually function of the characteristics of the productions that circulate through the port, both those that leave (export) and those that arrive (import). Most of the ports, which are in the surroundings of an urban region, were either responsible for the beginning of the city, or used the region's infrastructure for its viability. In any case, port and city are historically inseparable situations.

The port, in theory, generates income, employment and goods for the city, while the city, also in theory, generates labor, the most diverse services and its own urban infrastructure for the port. Porto and city support each other, or when managed inappropriately harm each other. Considering that the port occupies a part of the urban space, the different production chains pass through the city. The city as a "locus" of passage, or as a barrier, making it

difficult for this passage to the Hinterland (land part of the port) and the Foreland (part of berthing).

Containerization has profoundly transformed not only the world circulation system and the role of the port, but also the relationship between the port and the surrounding city (Figure 1). The traditional “situation income” generated by the consolidation and separation of cargoes in the port region is being replaced by a “transit income” as the port is becoming just another link in the chain where it transits the container [14]. The issue of deepening and expanding containerization is transforming the port city, which historically was a place of value addition, into an obstacle to the flow of the chain and its different modes, thus causing a "port-city divorce" [15].

A parallel consequence of containerization is the increasing limitation of port functions, which are increasingly restricted to the so-called “basic functions” which are mooring of ships and transshipment.

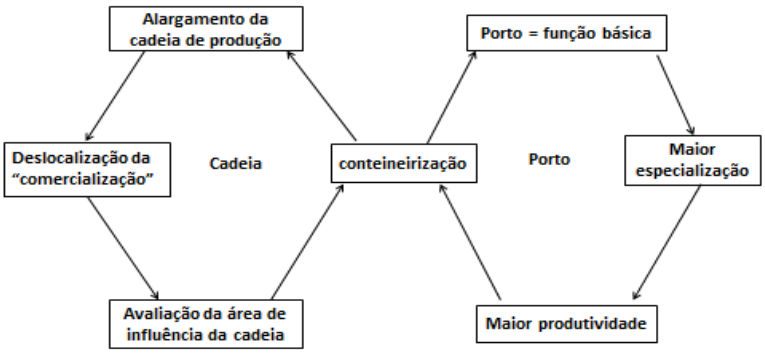


Fig.1 – The post containerization city-port dynamics

Source: authors, 2016.

Containerization has become an irreversible process for most products with high added value and causes important changes in the role of the port. The first is internal, within the port itself: it needs to perform its basic functions well (berthing and transhipment) and, for this, it needs to be “efficient”. The search for efficiency leads to a greater specialization of the routine activities of its basic functions, thus increasing the greater productivity of the port, which can and should be measured in terms of operating time, operating volume and operating cost.

Given this, the search for productivity, makes the port to privilege containerized cargo and, for this, orients its infrastructure to do so. The second major change caused by containerization is external to the port, in the production chain, that the port is just a link. After the exhaustion of the hegemonic idea of Fordism, where organizations sought centralization and verticalization, today, in the post-Fordist era, different sectors started to be responsible for just a few stages of production, thus giving rise to the idea of the “production chain”.

In terms of adequate conditions and the organization's viability, production has been expanded, especially after the 1970s. Until recently, however, many ports were still “outside” the production chain logic, but working with containerization, soon generating operational difficulties for themselves. When the paradigm is the reproduction chain, there is an expansion of the idea of production and the port can be considered as an operating unit (OU) or production unit (UP), which, articulated with the other links in the chain, can provide competitiveness for a particular sector or chain.

In this context Alves and Raia Júnior [16], argue that the current conditions of mobility and public transport services in Brazil direct the action of the Secretariat of Urban Mobility (Ministry of Cities) in three strategic axes that group the issues to be faced: a) to promote citizenship and social inclusion by universalizing access to public transport services and increasing urban mobility; b) promote institutional, regulatory and management improvement in the sector; and c) coordinate actions for the integration of mobility policies and these with other urban development and environmental protection policies.

However, the aforementioned “extension” of the chain makes it possible to relocate the commercialization of goods and services that historically were carried out in or around the port. This relocation of marketing, in turn, provides opportunities for the expansion of the area of influence of the production chain itself and its consequent globalization. Now, for this process to be improved, new OU and UP need to be added, generating, simultaneously, a search for international suppliers and an increase in the

circulation of containers within the production chain itself (Figure 2).

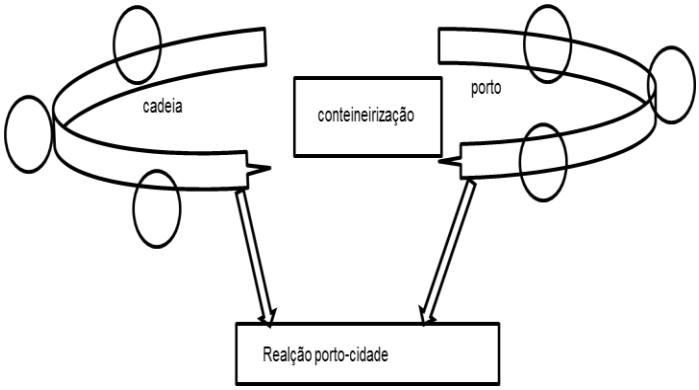


Fig.2 - The port-chain and its new dynamics

Source: authors, 2016.

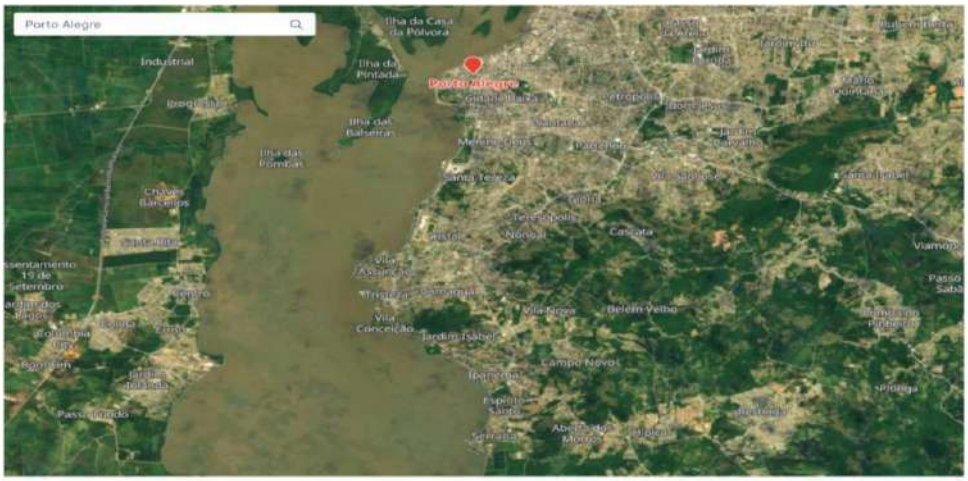
In this sense, you notice that there are two changes (Figure 2). One inside and one outside the port, profoundly transforming not only the role of the port, but also the port-city relationship. A challenge of "port governance", on the other hand, is to make the surroundings of the port area stop being an obstacle, defined by some authors of "roughness", and become a region of added value for the chains that circulate there [17]. Therefore, it is necessary to manage the "port-city" relationship.

II. METHODOLOGY

The adopted methodology was an exploratory and descriptive study of qualitative analysis through content analysis, and the data were obtained through secondary sources, using normative and legislative documents on port operation and urban mobility projects, available on the portals of the port of Porto Alegre and documents, data and information from the Municipality of Porto Alegre. It is based on the hypothesis that the data made available to these portals are trustworthy and real, as there is a whole "legal framework" that requires public organizations to be transparent in their actions, actions and decisions.

III. RESULTS AND DISCUSSION

The study outlined the relationships between urban mobility and the city-port linking path. The choice is due to the fact that Porto Alegre over the past ten years has been a protagonist in transformations, conflicts and a place for debate on social and environmental issues in a global context. The city of Porto Alegre was founded on March 26, 1772. In 2010, the city had 1,409,351 inhabitants, representing 13.2% of the population of the State of Rio Grande do Sul. With an area equal to 496.682 km², it has a population density of 2,837.53, with 53.61% of the population being women and 46.39% men, with an HDI of 0.865, with a humid subtropical climate. With an area equal to 496,682 km², it has a population density of 2,837.53, with 53.61% of the population being women and 46.39% men, with an HDI of 0.865, with a humid subtropical climate. Therefore, it is worth highlighting some facts peculiar to the city's history and its evolution and dynamics, such as after the end of the Farrapos War, the city resumes its development and undergoes a strong urban restructuring in the last decades of the 18th century, driven mainly by the rapid growth of port activities and shipyards.



Map 1- Map of the City of Porto Alegre- RS

Source: Google Maps, 2021.

Thus, development was continuous over time and the city remained at the center of cultural, political and social events in the country as a land of great writers, intellectuals, artists, politicians and events that marked the history of Brazil. Porto Alegre's Master Plan still dates from the beginning of the 20th century, with the so-called "General Improvement Plan" in 1914. However, the first attempt to implement a global vision of the city's problems was a typical road plan, based on well-defined guiding principles, establishing the need to create sufficiently wide access roads to relieve traffic from the Center to the periphery and vice versa. The watchwords were: “extend, widen, open avenues”. Thus, roads of fundamental importance in the structuring of the city were designed. However, according to federal law 12.587/2012 of the Ministry of Cities, which determines that cities with more than 20,000 inhabitants prepare their Urban Mobility Plans, in this sense the city fulfills the requirement with the PlanMob of Porto Alegre.

The capital of the state of Rio Grande do Sul, it is a city that is home to several ethnic groups. In the last decade, it has hosted several events such as: World Social Forum, Freedom Forum, 2014 World Cup, and many other events that require mobility and a sustainable city able to receive visitors and provide an adequate synergy between visitors and visitors under the conditions of an infrastructure with adequate load capacity and its range of and urban traffic.

All these mobility management issues are enhanced when the city is a port. The biggest problem, in these cases, is to ensure that the city does not have its back to the port and manages to integrate the port and its activities with the dynamics of the city itself. For this, both the port and the city need to carry out their plans taking into account the “other”, such as Valencia (Spain) and its port. Considering that containerization is inevitable in the short and medium term, a third actor needs to be considered here, which is the supply chain or economic sectors that use the city and port structures (Figure 3).

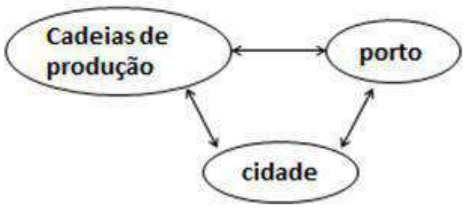


Fig.3 – Port-city connections

Source: authors, 2021.

For integration to take place (Figure 3), urban planning, when containerization emerges, needs to adjust and consider the specificities of the products that circulate there, in order to become a support site for the production system and not an urban barrier. The port planning needs, after respecting the legislation, to consider the urban specificities of its surroundings, as well as the fundamental characteristics of the sectors that use the port to, for example, build a retro port area or a zone of logistical activity (ZAL) that can leverage the competitiveness of port users.

The Port of Porto Alegre is located on the banks of the Guaiba River. The management program for the port and its surroundings, which includes the different secretariats and departments such as: the Environment (Smam) and Culture (SMC), the Special Secretariat for Accessibility and Social Inclusion (Seacis), and the municipal departments of Water and Sewage (Dmae), Rain Sewage (DEP) and Urban Cleaning (DMLU). Its management

considers the following objectives: a) urban planning and development of the Municipality, counting on the participation of society in the elaboration and monitoring of urban development programs, with a view to designing and building the Porto Alegre of the future; b) acting in places that offer development opportunities for the city, as well as in degraded areas, seeking their regularization and revitalization through infrastructure improvements, without neglecting the preservation of areas of environmental and cultural importance for the city; and finally c) optimize and integrate transport modes, alleviating downtown pollution; and d) expand the city's sewage and water treatment networks in order to avoid environmental contamination, improve the bathing conditions of Lake Guaíba and, consequently, provide the population with quality of life [18].

Rocha et al. [19], highlight the need to consider Mobility Management strategies in a way that adheres to the cultural, social and economic model of each community, guaranteeing their explicit participation in the decision-making process. Mobility Management could, in this way, contribute to the mitigation of impacts generated in the operation of transport systems and promote greater democratization in the implementation of actions that aim to ensure greater balance in the occupation of urban space.

The National Urban Mobility Policy adopted by the Ministry of Cities aims to discuss issues related to Sustainable Urban Mobility in the city. For this, the following measures must be taken: a) emphasize the use of collective transport and not individual transport; b) reduce congestion in the city; c) reduce environmental pollution generated by means of transport; d) reduce the number of traffic accidents; e) encourage the use of non-polluting and renewable fuels; f) guide public investments in the transport sector; and g) guide the equipment, the distribution of transport infrastructure, the circulation and distribution of goods and people in the city. Thus, the twenty-nine guidelines of the National Urban Mobility Policy are based on the objective of prioritizing pedestrians, cyclists, public transport passengers, people with disabilities, people with special needs and the elderly, in the use of urban circulation space [16].

According to data from PlanMob-Porto Alegre, the city currently has 81 official neighborhoods, whose boundaries are defined by 28 specific laws. There are still some areas of the territory without an official name (such as Indefinite Zones) and which are known by the population by local names, such as Morro Santana, Passo das Pedras and Aberta dos Morros. The city's neighborhoods are distributed throughout the city's territorial area, covering the north, south, east, west (on the islands of Lake Guaíba) and in the central area, which, due to its occupation process, is located in the peninsular region by the lake.

After several municipal political incentives, the city underwent a decentralization of activities that were traditionally located in the center, thus generating new regional centers that were consolidated over the last few decades. This model allowed the creation of new poles of attraction due to both services and commerce, as well as industries consolidated in different regions. However, despite this process, the historic center still remains today as a major commercial, service and cultural hub, attracting a circulation of people and vehicles, which is still expressive. In the period 2013/2014, the city of Porto Alegre had several urban mobility works started, due to the World Cup, which impacted the system's operation.

Porto, mainly in the region around the Mauá Wharf, is close to the historic center of Porto Alegre. According to the SPH (Superintendence of Ports and Waterways) (2015), the Port of Porto Alegre, despite having fluvial characteristics, is classified as a sea port, according to Resolution No. 2969 -ANTAQ, of July 4, 2013. It maintains eight kilometers of berth, divided between the Mauá, Navegantes and Marcílio Dias docks [20].

Map 2- Mauá Wharf

Source: Google Earth, 2016.

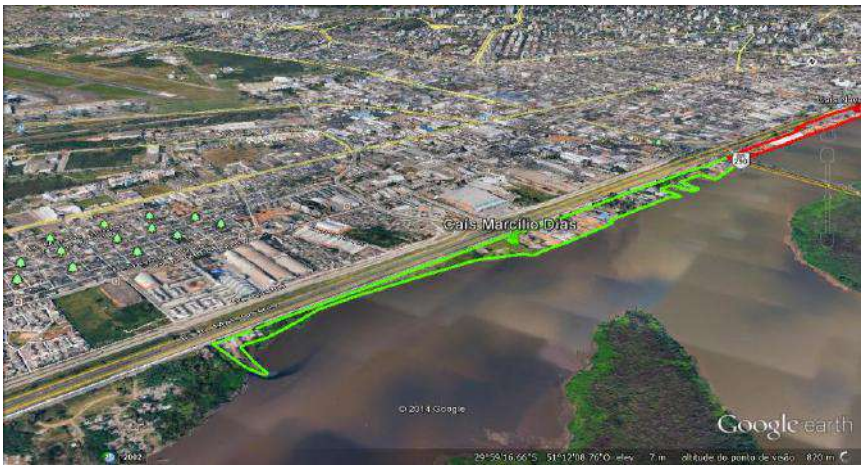
Its structure involves 25 warehouses with 70 thousand m², in a total area of 450 thousand m². Since the first half of 2005, the operating area of the public port has been concentrated on the Navegantes wharf, which has been qualified in the international ISPS-CODE safety standards since 2010. It has the capacity to operate up to 3 long-haul ships simultaneously.

At the end of 2012, the port of the Capital Gaúcha started to participate in the program developed by the Federal Government, called Porto Sem Papel - PSP, where all its port data are concentrated, sharing them with the consenting bodies (Federal Police, Federal Revenue, VIGIAGRO, ANVISA, Brazilian Navy, among others).

Map 2- Navegantes Wharf

Source: Google Earth, 2021.

The Navegantes wharf is 2,500m long, 20m wide, 5 to 6m deep and has a height of 3m. It is intended for commercial cargo, but its zoning has distinct areas for multipurpose, grain, fertilizer and general cargo terminals, especially in the region called Marcílio Dias (Map 3).



Map 3- Marcilio Dias Pier

Source: Google Earth, 2021.

Since 2010, the logistical movements of the Port of Porto Alegre, together with the private terminals, move about 6 million tons/year, in products such as maritime platform mooring ropes, fertilizers, salt, vegetable grains , electrical transformers and cellulose and in 2018 it registered the movement of cargoes of 7.1 million tons, through the port complex that involves: Porto Alegre, TUP CMPC Guaíba, Santa Clara Terminal, TUP Oleoplan, TUP Bianchini Canoas, ETC Yara Porto Alegre, Niterói Waterway Terminal, Tergasul and TUP SHV [21].

The projection of the studies indicates a trend scenario, the demand for the Port Complex should grow, on average, 0.9% per year, between 2018 and 2060, in an optimistic

scenario, this rate is 1.0% per year; in the pessimistic scenario, there is an average annual growth of 0.7% for the same period [21]. Currently, waterway transport accounts for only 4% of the State's navigation matrix capacity use. The expansion of the use of the waterway is a global trend, as a matter of environmental and economic sustainability. Sooner or later, companies, especially those engaged in environmental preservation, will use the modal more frequently. The government's goal is to increase the share of cargo handling by waterway in the Port of Porto Alegre [21].

The municipal public administration of Porto Alegre has been developing Sustainable Urban Mobility projects, whose main premise is the adoption of an integrated transport system with operational flexibility, minimizing the need to carry out compulsory transfers for neighborhoods with high demand and constituting in the functional restructuring for the physical, operational and tariff articulation of the city's public transport system.

The sustainability axes, which are necessary for the development and implementation of the Integrated Transport Plan, were detailed in PITMUrb as follows: a) institutional integration; b) integration of transport and urban and environmental interventions; c) functional integration of transport; d) tariff integration; e) integration of control and information to the user; and f) financing integration. The axes are interconnected (Figure 4).

Fig.4 - Axes of sustainability of the Integrated Transport System (SIT) in Porto Alegre, Rio Grande do Sul.

Source: PlanMob Porto Alegre, RS 2015.

The Action Plan for the Integrated Transport System was prepared with the PITMUrb as a reference, and aims to establish, in partnership with the State of Rio Grande do Sul (Metroplan), the Metropolitan Transport Consortium, as provided for in the Integrated Transport Plan and Urban Mobility (PITMUrb) and formatted in Law 11.107 / 2005. For its implementation, it is essential to understand the spheres of government involved, through an institutional structure that can design, design and implement an Integrated Transport System (SIT), define and implement the policies necessary for sustainable development, define and execute the services to be explored by the private sector in a coordinated way for all modes, implement a new regulatory framework and monitor the bidding of concessions for different types of services in the new system.

IV. FINAL CONSIDERATIONS

The most important issue when working with the port-city relationship is the alignment of public policies aimed at Urban Mobility issues in Porto Alegre. Because, the city is in a context of political, economic, environmental and social changes that configure a scenario of uncertainties on how to replan the city for Porto Alegre and for those who pass here, because the conflicts and shortages are evident and complex.

It is believed that it is possible to think about actions for a better logistical development of the city. PlanMob-Porto Alegre, which is currently being implemented with actions to improve the edge of the Porto Alegre port complex, such as leisure and entertainment spaces, actions to improve physical capacity and port berthing in the commercial and customs area have not yet been realized. The economic potential of the Port of Porto Alegre may boost and greatly favor the local and regional economy, but it needs attention from the public sector and the local community needs to establish a closer and more responsible relationship with the Port and its shoreline.

The city of Porto Alegre has potentials that favor the insertion and operation of the most varied modes for urban mobility, as its geographic location makes it one of the central axes of the State of Rio Grande do Sul for the flow of crops and the circulation of goods and people. It is perceived that it is a city in transformation that needs aligned public policies that effectively and efficiently meet the demands of the sustainable development of the economy in line with social, environmental and cultural issues.

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Epidemiological risk in the movement of cattle in the regions of critical control points for foot-and-mouth disease in the state of Mato Grosso do Sul

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***Keywords*— Critical Control Point, Cattle Movement, Foot-and-Mouth Disease**

***Abstract*—** *Cattle ranching in the state of Mato Grosso do Sul has been a supporter of the state's agribusiness, which has one of the largest cattle herds in the country, and has in its extensive breeding system a high genetic herd and the animals have access to an excellent pasture in the face of good quality of the fertile lands of the state. This activity generates directly and indirectly approximately 38,317,000 jobs and moves 24 billion reais annually, and this financial movement has increased by 18.2% in 2021 compared to the previous year (DETEC/Famasul System,2021), contributing to the state's GDP of R$ 23.5 billion, with an expected growth of 3.5% in 2021 (Tavares, 2021). The Agency for Animal and Vegetable Agricultural Defense - IAGRO has developed a work recognized nationally and internationally. In view of the state having approximately 1,500 kilometers of border, strict control of critical animal movement points in these regions is necessary. To date, 38,526 Animal Transit Guides - GTAs have been issued totaling 1,419,364 cattle and buffaloes moved in these regions. Thus, IAGRO performs continuous and uninterrupted work of sanitary surveillance in these regions, with actions of irregular traffic inhibition and regular traffic control. In 2021, in these regions, 125 searches were conducted for absentees, 362 vaccinations accompanied by the official service and 45 records of infractions for non-vaccination and 34 for lack of registration of*

the vaccine. (IAGRO,2021). All this health surveillance work aims to maintain the protection of the entire herd of the state of Mato Grosso do Sul resulting that for more than 15 years without record of aftosa focus in the state, we maintain a vaccination coverage above 99.2% to more than 6 years and the state pleads for the status of aphthous-free area without vaccination, demand from IAGRO and the entire production chain of the state. We will remain firm, convinced that work must continue and improve with health defense actions, health education, technical staff training and health surveillance throughout the state, with emphasis on the entire international and interstate border region.

I. INTRODUCTION

With the high increase in the consumption of protein of animal origin, due to the population growth of the world, and having Brazil as one of the largest producers and exporters of beef, and Mato Grosso do Sul being one of the main federative entities, responsible for the export of meat to several countries, which increases the revenue of the state and the country, generating numerous direct and indirect jobs, it is of paramount importance to control diseases among them Foot-and-mouth disease, which is a health barrier for international trade, causing high expenses for its control and eradication, huge losses in cases of outbreak [1] and due to the fall in herd productivity, in addition to economic losses and meat importing markets and indemnification when necessary animal sacrifice [2].

Given the importance of the eradication of foot-and-mouth disease, with regard to the prevention of animal health and national socioeconomic development, we perceive the need for analysis and evaluation of the epidemiological risk of this disease in the country.

Animal transit and the movement flow of cattle have always been recognized as predominant factors for the spread and occurrence of diseases throughout Brazil, as described in a study between 1960 and 2002 and reported by Felipe et. al. (2010). In Minas Gerais, from 1992 to 1994, 69% of the properties affected with foot-and-mouth disease had the introduction of animals. This process of cattle entry made the properties more vulnerable to the introduction of the virus, attributing to cattle transit a primary role in the spread of diseases. Thus, to understand the risks of diseases, it is necessary to know animal movement, which must be complemented with a global surveillance system and fostered by traceability tools [3].

Thus, this study aims to characterize the epidemiological risks in the movement of cattle in regions of critical control points, for foot-and-mouth disease in the state of Mato Grosso do Sul.

a) The geographical characterization of the state of Mato Grosso of Sul

Located in the south of the Midwest Region, it is limited to five states: North - Mato Grosso; Northeast - Goiás and Minas Gerais; East - São Paulo; Southeast - Paraná and two countries: Bolivia to the west and Paraguay to the South and Southwest.

According to data from IBGE and the Government's Institutional Page, Mato Grosso do Sul has the following characteristics: divided . The largest urban concentrations are in the Center - Campo Grande, Centro-Sul - Dourados, East - Três Lagoas and Noroeste - Corumbá. It occupies an area of 357.145.532 km², with a population of 2.839.188 inhabitants as of July 1, 2021- the 21st most populous state in Brazil.

The Pantanal occupies the western end of the state, to the east and southeast are the mountains of Bodoquena, Maracajú and Amambai, forming the Plateaus and to the northwest are the Plains. The main rivers are Paraguay, Paraná, Paranaíba, Miranda, Taquari, Negro, Apa, Dourado and Correntes [4].

Also according to recent data from IBGE, the main economic activities are beef and dairy cattle, soybean, corn, sugarcane, cotton and rice crops, the pulp industry and iron, manganese and limestone mining.

The north of Mato Grosso feared the economic impact of the separation of the south, the separatist movement comes from the first decades of the twentieth century and on October 11, 1977, the dismemberment of Mato Grosso do Sul took place. On January 1, 1979, President Ernesto Geisel elevated MS to the category of State [5].

Mato Grosso do Sul is formed by two large regional complexes: Plateau in the sense NNE-SSE - a little bumpy topography that contributed to the expansion of modern commercial cultures, technical and sensitive to innovations, characterizing it as an important set of the territorial division of labor and the Pantanal in the SENSE NO-SO - biome whose remarkable presence of flooded areas, firm soil and transition areas compose a natural mosaic whose abiotic and biotic diversity, leads to the rational use of space. It is worth mentioning that the presence of livestock activity is felt in both macro-regional groups [6].

The process of storage and spatial organization of livestock production and the institution of the South-Mato Grosso identity can be understood from eight intense moments [7], namely, I - related to the genesis of mining activity in the eighteenth century; II - corresponds to the moment of land storage after the Paraguayan War in the 19th century; III - constituted by the reflections of the monopoly of the Matte Larangeira Company, between the end of the 19th century and the beginning of the 20th century; IV - marked by the expansion of foreign capitals (charqueadas) and the international market, before and after the First World War; V - closely related to the expansion of the cooled meat market, the implementation of refrigerators in the state of São Paulo and the intensification of rail transport through the Northwest of Brazil, between the first and second half of the twentieth century; VI - has connection with state policies, more precisely the march to the West and the expansion of agricultural frontiers, marking the phase of expansion of new crops through the cerrado; VII - the crisis of the 1980s denotes an internal re-organization of production; VIII - characterized by the opening and consolidation of markets accompanied by innovation strategies in the face of the demands of international competitiveness.

The peculiar cattle ranching of MS had its origin marked by the different fronts of settlement, since the seventeenth century, going through different processes of organization, allowing it to gradually acquire a status of relevance in the socio-spatial formation of the state, not constituting only a reflection of other formations - minas gerais, paulista or gaucho [7].

Also according to Bertholi (2006), the non-Indian occupation of the South-Mato Grosso space, considering the multiple determinations regarding the motivation of the various groups that entered the territory and constituted the production relations, it is worth mentioning three: the first conducted by the natural veins of the Tietê, Paraná, Pardo, Taquari and Paraguay rivers, the second as a strategy to guarantee land ownership by the Brazilian interior, of strategic-military bias, of the foundation of fortifications in the border areas and finally, of that under the political determination of granting glebes to influential groups. All these motivations contributed to insert the former South of Mato Grosso into the dynamics of capitalist relations of production, allowing the places to overcome the status of paradouros and definitively establisha relationship with the territorial division of labor[7].

This whole process of occupation, conducted or through the veins of the rivers that cut through the territory and join the Plateau to the Pantanal, or by the interests of the imperial government in securing the ownership of the lands in the face of the Spanish offensive, meant the arrival of new social formations and the definitive establishment of relations of southern Mato Grosso with the dominant and universal modes of production [7].

The banks of the rivers served primarily as a resting place for the Monsoon, especially those where the cities of Camapuã and Coxim were later founded. Others, such as Corumbá, Aquidauana and Aparecida do Taboado enabled the development of local commerce thanks to the privileged geographical position, in the path of the platinum market, on the way of the market with Campo Grande and on the way with the mining market, respectively. Unlike Amambaí and Bela Vista who assumed a character of Entreposto de Gado, as well as those who were in the territory of Matte Larangeira served as Entreposto de Erva, as Ponta Porã and Caarapó [7].

> *"In this dynamic, highlighted by Campo Grande, located between the areas of Vacaria and the main marketing routes, it connected the markets of the major Brazilian centers to the platinum and the most remote areas of the North (via the port of Corumbá), thus becoming the most dynamic center of the state, already at the beginning of the twentieth century".[7]*

According to updated data from AGESUL - State Agency for Project Management, highways and roads in Mato Grosso are divided as: Federal: 3.012.4 kilometers on 12 paved highways; State: 14.586.60 kilometers, of which: 1,915.4 planned, 8.548.3 unpaved and 4.122.9 paved. Municipal highways are composed of 45.176.8 kilometers of roads in natural bed.

b) Cattle ranching and buffalo in the state of Mato Grosso do Sul

The state of Mato Grosso of Sul was divided into four mesoregions and 11 microregions (Fig. 1) based on multithematic socioeconomic and geopolitical characteristics [8], which can facilitate the understanding of the spatial distribution of agricultural production chains and livestock.

According to data provided by IBGE (2020) the state has a staff of 19,027,086 cattle and 16,369 buffaloes. The livestock production of beef cattle is more expressive, with slaughter of approximately 3,389,421 heads, representing 11.34% of the national slaughter of cattle (BRASIL, 2020). The 10 municipalities with the highest cattle count are: Corumbá (1,927,002 heads), Ribas do Rio Pardo (1,085,497 heads), Aquidauana (794,825 heads), Porto Murtinho (647,006 heads), Santa Rita do Pardo (544,691 heads), Rio Verde do MT (533,366 heads), Campo Grande (520,524 heads), Três Lagoas (500,672 heads), Água Clara (485,095 heads) and Brasilândia which presented 463,033 head of cattle [9] [10]

The municipalities with the highest cattle are concentrated in the mesoregion of Baixo Pantanal and Três Lagoas, where extensive breeding systems are traditionally developed for the production and commercialization of beef calves for breeding and fattening in areas with availability of food in quantity and of superior quality [11]. It is emphasized that the mesoregion of Três Lagoas has replaced livestock activity with pulp and paper production, which probably determines changes in land use and occupation in this region.

According to Hott et al. (2021) the state's dairy production in 2019 was equivalent to 0.81% of the national production. In 2020, 162,783 cows were milked and dM milk production was estimated at 295,940,000 liters. Among the 10 municipalities, with the highest number of cows milking, are Paranaíba (14,299 heads), Itaquiraí (11,446 heads), Nova Andradina (10,649 heads), Sidrolândia (9,627 heads), Terenos (8.4 11 heads), Iguatemi (6,295 heads), Camapuã (6,190 heads), Ponta Porã (6,158 heads), Aparecida do Taboado (6,004 heads) and Innocence, with 5,031 cows milked during this period [12][13].

Mato Grosso do Sul has eight dairy basins: the Southern Cone, Nova Andradina, Glória de Dourados, Dourados, Aquidauana, Campo Grande, Centro-Norte and the Bolsão basin. The characteristics of the production chain include low level of information and training, low productivity and small production volumes, financial economic insufficiency and low membership in associativism and cooperativism. In the MS more than 50% of milk is produced in properties with less than 50 hectares, by family farming [14].

The particularities of livestock activity directly interfere in the dynamics of events related to health problems, including in relation to AF. Thus, the strategy of establishing livestock circuits as a complementary concept to the biological focus given to the concept of AF ecosystem (host-environment agent) was important from 1992, because a new stage intended to invest in the eradication of the disease and, for this, the involvement of the entire production chain would be fundamental. The delimitation and definition of livestock circuits (Fig. 2) was carried out after a comprehensive evaluation of these characteristics and with the participation of representatives from different sectors, considering four types of activity: extractive livestock, mixed livestock for meat, livestock for milk processing and market activity [15].

In this context, studies on the distribution of herds, land structure and the transit of these animals, for different purposes, can clarify more particularly how agricultural circuits work.

Evaluating aspects of land use within the dynamics of production chains of different species and their role in the implementation of different strategies for control and eradication of AF are fundamental for the success of PNEFA in the MS [16], especially in view of the distribution of small properties, location in settlements and indigenous areas (Fig. 3), cultural, socioeconomic, breeding practices and movement among small producers.

The stratification and analysis of the characteristics within the different livestock circuits can contribute to the success in the eradication of AF in the state, corroborating Moraes et al. (2017) that described technological innovations, institutional organization, shared responsibility and increased epidemiological surveillance as fundamental conditions for this to occur [17].

Fig. 1: Mesoregions and microregions of the state of Mato Grosso do Sul. Source: [8]

Fig. 2: Brazilian livestock circuits, defined for strategies of actions to control and eradicate foot-and-mouth disease. Source: Moraes et al. (2017).

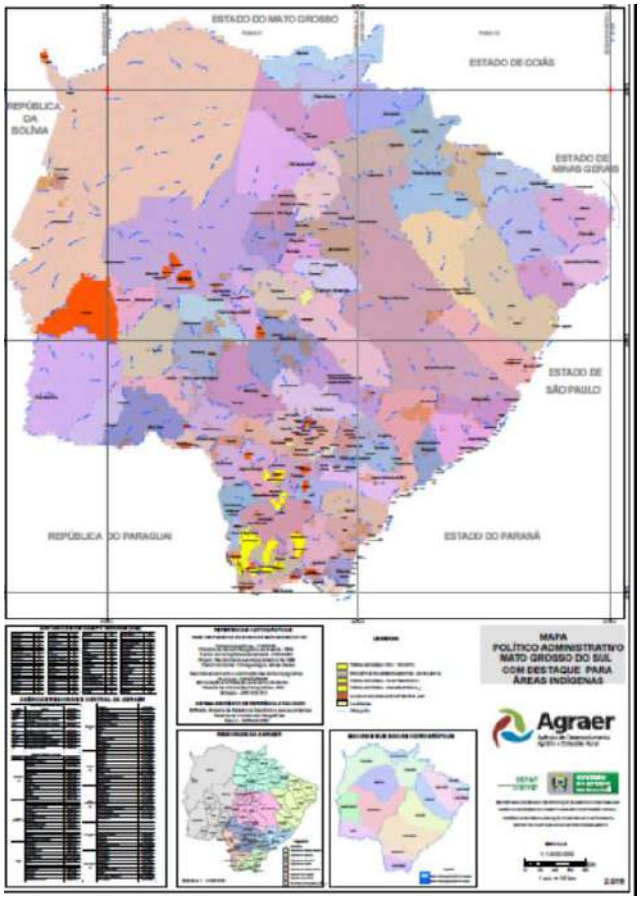


Fig. 3: Administrative political map of the state of Mato Grosso do Sul, with emphasis on indigenous areas and rural settlement projects. Source: AGRAER (2021).

c) The importance of agricultural activity in the state of Mato Grosso do Sul

The primary sector is the main economic activity of Mato Grosso do Sul, and livestock activity occupies a prominent position in this scenario, which causes a large volume of beef exports from the state to all continents. Given this context, this activity has a great impact on the state's trade balance, which makes this activity very competitive and technical [17].

Mato Grosso do Sul, according to updated data from the State Agency for Animal and Plant Sanitary Defense (IAGRO), has a cattle herd of 17.7 million, and with the highest concentration in the municipalities of Corumbá with 1.8 million, Ribas do Rio Pardo with 940,000 and Aquidauna with 779,000, and the state has the 5th largest herd in the country [18].

In 2020, a total of 3,347,680 cattle [18] were slaughtered in the municipal, state and federal inspection services, which moved US$778,246 million and

210,642,000 tons of beef [19] were exported. Hong Kong stands out with 23.92% of the countries that imported beef the most in the state of Mato Grosso do Sul, followed by China with 16.25% [20].

Cattle ranching in the state of Mato Grosso do Sul directly and indirectly generates approximately 38,317,000 jobs and moves 24 billion reais annually, and this financial movement has increased by 18.2% in 2021 compared to the previous year [21], contributing to the state's GDP of R$ 23.5 billion, expected to grow by 3.5% in 2021 [22].

d) Foot-and-mouth disease virus in Brazil, the midwest and Mato Grosso do Sul

The first description of cases of foot-and-mouth disease (AF) was made by Giorlano Fracastorius, in 1514, in the verona region of Italy [23]. In South America, the occurrence of AF was documented in 1870, almost simultaneously in the Province of Buenos Aires (Argentina), in the central region of Chile and uruguay [24]. It is suggested that the occurrence of foci occurred through the trade of animals from Europe (endemic region) [25], mainly through the import of breeding cattle to meet the growing demand for production linked to the development of the refrigeration segment [26].

Chile detected its first outbreaks in 1871 and the FA spread to Brazilian states in the 20th century, in addition to other countries such as Paraguay and Peru (1910), Bolivia (1912), Venezuela (1950), Colombia (1950/1951) and Ecuador in 1956 [25]. In this context, South America was characterized as an endemic area for this disease.

It assumes that the Southern region of Brazil has been affected due to the outbreaks recorded in the Southern Cone region of America, however, the first officially recognized case in the country occurred in 1895 in the city of Uberaba in Minas Gerais and the following year, in 1896, in the state of Rio Grande do Sul and again in the Region of triângulo Mineiro, import of animals from Europe [15][24].

Several decades passed after the first records of AF, until an intervention was initiated for its control in Brazil [24].

In the 1960s, the first program to combat foot-and-mouth disease involving Banco do Brasil credit lines was developed and, simultaneously, the introduction of infrastructure in laboratories, training of people, awareness of producers, production of vaccine, notification of outbreaks and diagnosis of the disease was established [26].

In the 1970s, the intensification of surveillance resulted in higher reports of outbreaks and epidemiological studies identified risk areas and correlated the regions of AF occurrence with the movement of animals. The investment in vaccine quality control was paramount for the success of health programs [2], since at that time, outbreaks occurred in herds with low immune coverage due to the use of vaccines with low immunogenic quality. In 1976, 48% of the outbreaks recorded were an epidemic outbreak in Rio Grande do Sul by the type "A" virus, going to the states of Bahia, Minas Gerais and São Paulo, representing the total of 70% of the outbreaks recorded in Brazil. In 1980 the "O" virus was responsible for a new outbreak in Rio Grande do Sul [24].

Since 1980, studies have shown that the disease was influenced by the movement of cattle and the characteristics of the regions [2] and, then, a sharp drop in the number of outbreaks was observed as a result of the strengthening of the control activities of the Official Veterinary Service (SVO), vaccination campaigns with greater availability and quality of the vaccine, which, since 1978, it has been submitted to production for evaluation by the Ministry of Agriculture, and the consolidation of programs to combat foot-and-mouth disease in the Southern Region of the country (region with the highest number of cases of the disease) (MORAES, 2018). The implementation of the Hemispheric Plan for the Eradication of Foot-and-Mouth Disease (PHEFA) in 1987, added to what had been carried out, resulted in a significant decrease in the number of foci, maintaining this trend until 1991 [27].

The upsurge in outbreaks from 1992 to 1994 was a reflection of improvements in notification by state veterinary services (ES) and in the intensification of cattle marketing and transit, stimulated by financial speculation. However, the SVO interfered intelligently, restricting the transit of animals, and the situation normalized in 1995 [24].

In the 1990s, the important aspects of cattle production chains were addressed in studies and the transit of animals was characterized as one of the largest disseminators of the disease, which was fundamental to understand the spatial distribution of AF and its relationship with agricultural activity. The types of ecosystems of the disease determined by these studies were essential for the determination of livestock circuits and the creation of different public policies [15]. The modernization of refrigeration industries to places closer to cattle breeding, avoiding the displacement of animals over

long distances, and the exclusive use of the vaccine with oily adjuvant throughout Brazil, were important factors for the eradication of the disease [9].

In 1998, Rio Grande do Sul and Santa Catarina were internationally recognized as an AF-free zone with vaccination. However, that same year, outbreaks were recorded in Mato Grosso do Sul, in the municipality of Porto Murtinho and, the following year, in Naviraí, both located in the international border region [24]. According to Amaral et al. (2016) [28], vulnerability to the entry of foot-and-mouth disease in this region bordering Paraguay is associated with the introduction of animals into the properties, distance from properties to the border and small properties of rural settlements.

Souza (1999) [30] gave a description of the actions to attend the outbreak of Porto Murtinho and Naviraí, MS. The notification of Porto Murtinho was made in February 1998 and the occurrence was finalized in May, were two outbreaks detected in properties distant 45 km, belonging to the same tenant. The vulnerability of the Pantanal Sul region had already been signaled by Moraes et al (1997) [30] as a result of serological analyses and interviews with producers in municipalities in the region, although vaccination coverage was satisfactory and serum positivity was low, it is noteworthy that the municipalities of Aquidauana and Porto Murtinho had the highest frequencies of serum positivity for the stratum evaluated in the years 1995 and 1996.

In January 1999, the suspicion of vesicular disease was reported in the municipality of Naviraí and care measures were immediately applied to the first focus and the second focus was identified the following day. On January 30, 1999, the two properties were cleaned and disinfected and the sanitary void was started [29].

Reintroductions of foot-and-mouth disease in Rio Grande do Sul were reported in 2000 and 2001 as a consequence of later confirmed animal health problems in the province of Formosa, Argentina, on the border with Paraguay, involving viral types A and O (BRASIL, 2021) (MORAES, 2018). In August 2000, the first notification occurred in the municipality of Joia-RS, and the disease spread to three other municipalities (Eugênio de Castro, Augusto Pestana and São Miguel das Missões). The total of 22 foci distributed in the four municipalities was recorded and there was the sanitation of 142 properties considered as contact, with the sacrifice of 8,185 cattle, 772 sheep, 04 goats and 2,106 pigs as reported by Gocks (2012).

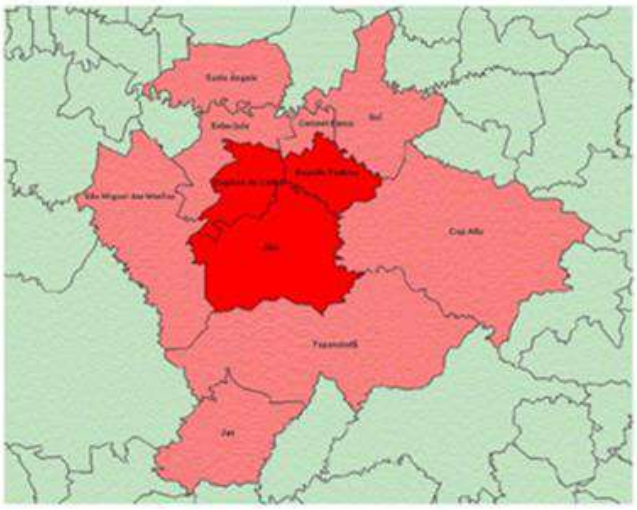


Fig. 4: Restricted area defined at the beginning of health emergency actions in RS in 2000. Source: Brazil (2020).

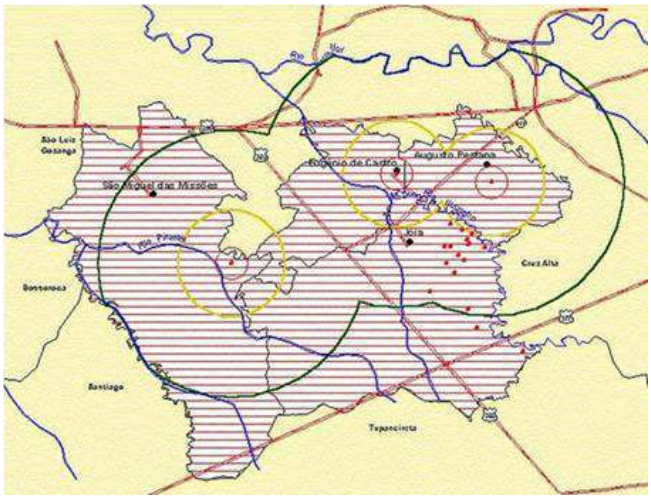


Fig. 5: Geographical representation of the areas of epidemiological risk established around the outbreaks located in the municipalities of Augusto Pestana, Eugênio de Castro and São Miguel das Missões - RS, 2000. Source: Brazil (2020).

In May 2001 a new case was confirmed in Santana do Livramento-RS due to indirect movements in the triple border region. The epidemiological link was identified through laboratory confirmation of type A virus with antigenic characteristics similar to those in Argentina and Uruguay. From May to July 2001, 30 foci of AF in RS were reported as described by Gocks (2012), 01 in Santana do Livramento, 05 in Alegrete, 03 in Quaraí, 02 in Dom Pedrito, 01 in Jarí and 18 in Rio Grande. 11,761 cattle, 5,039 sheep and 05 pigs, which were exposed or showed signs of the disease, were sacrificed and activities ended in October of the same year.

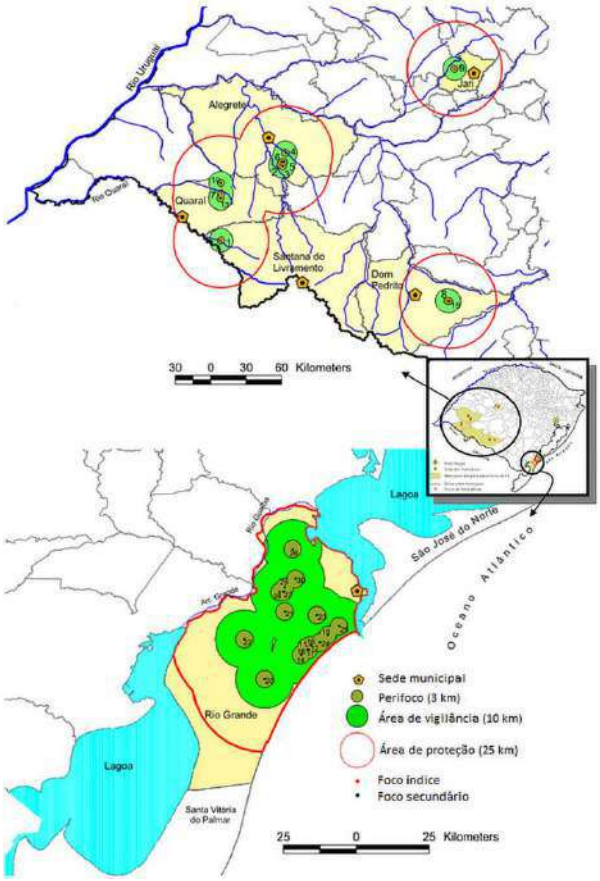


Fig. 6: Geographical location of foot-and-mouth disease foci, with emphasis on emergency areas in RS, 2001. Source: Brazil (2020).

These impactful data reinforce the complexity of health defense work and the importance of health education that can positively interfere in the intensification of passive surveillance, in the agility of notifications and control procedures performed by the SVO, which must present interaction with the productive sector, among other aspects, in to be efficient (GOCKS, 2012).

In 2004, occurrences of foot-and-mouth disease were recorded in the state of Pará with a focus of type O virus in the municipality of Monte Alegre and four outbreaks of type C virus in the state of Amazonas. The focus on Monte Alegre-PA was recorded during a suspicious care by the Official Veterinary Service, in a bovine with a discrete clinical sign in only one paw (BRASIL, 2009). In eliminating the focus, inspection and surveillance work was carried out involving 453 herds, a total of 14,462 cattle, 2,393 buffaloes, 1,221 pigs and 142 small ruminants inspected with the sacrifice and destruction of the 130 susceptible animals found in the focus and 31 contacts.

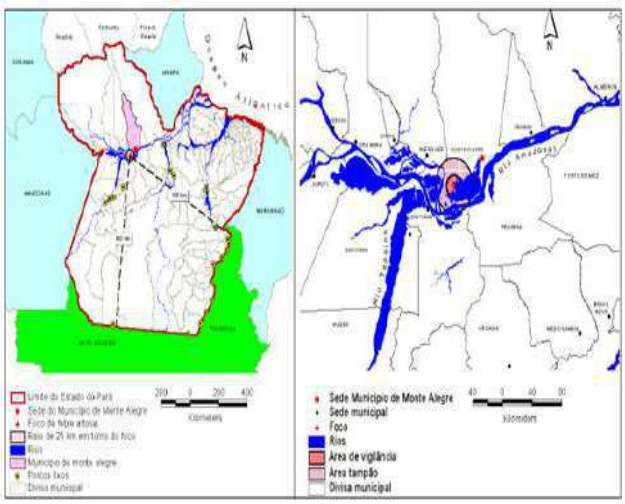


Fig. 7: Location of the foot-and-mouth disease outbreak and safety area in the municipality of Monte Alegre, Pará, Brazil. Source: Panaftosa (2005).

In September of the same year, the positive diagnosis of foot-and-mouth disease, virus C, was confirmed in epithelium samples of cattle located in the municipality of Careiro da Várzea, Amazonas. Clinical signs compatible with the disease were identified by the Amazon Animal Health Defense Service in 04 cattle from 12 to 24 months of age. In the property involved there were 34 cattle, 15 sheep and 01 pigs, and in 2003 and 2004 vaccinations against foot-and-mouth disease had not been recorded (PANAFTOSA, 2005).

Fig. 8: Geographical location of foot-and-mouth disease outbreak in Careiro da Várzea, Amazonas, Brazil. Source: Panaftosa (2005).

Fig. 9: Satellite image of the detection zone of c virus cases in Amazonas, Brazil. Source: Panaftosa (2005).

The last cases of AF in Brazil were recorded in Mato Grosso do Sul and Paraná, in the years 2005 and 2006, as described by Moraes (2018). In September 2005 a new epidemic caused by serotype O affected the municipalities of Eldorado, Japorã and Mundo Novo, located in the southern border region of Mato Grosso do Sul. A total of 33 foci were detected over a two-month period, and 660 cases (cattle) were reported to OIE and 26,553 cattle, 566 pigs and 626 sheep and goats were sacrificed. In Paraná, 07 outbreaks with 20 bovine cases were reported in five municipalities: Bela Vista do Paraíso, Grandes Rios, Loanda, Maringá and São Sebastião da Amoreira. Between December 2005 and February 2006, 6,781 cattle were sacrificed until the resolution of the foci (PNEFA, 2008a; PNEFA, 2008b; NEGREIROS et al., 2009; OIE-WAHIS, 2021).

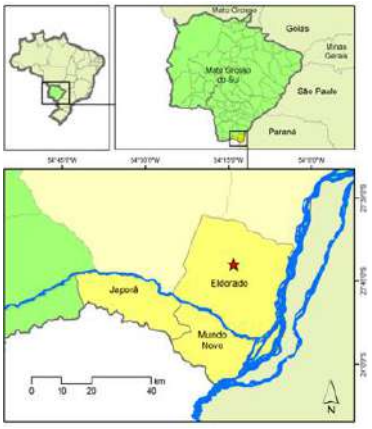


Fig. 10: Representation of the municipalities involved in the outbreak of foot-and-mouth disease in Mato Grosso do Sul, in 2005. Source: PNEFA (2008b).

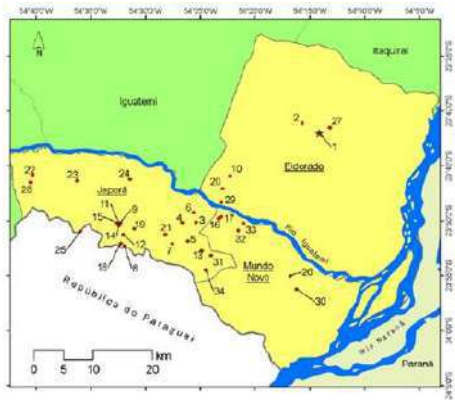


Fig. 11:. Location of the foci recorded in Mato Grosso do Sul, 2005 and 2006 (the identification number of the foci corresponds to the detection sequence). Source: Brazil (2020).

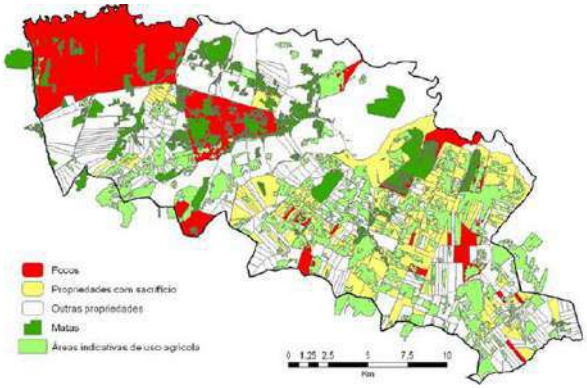


Fig. 12: Map of the Municipality of Japorã, MS, 2005 (highlight for properties notified as focus and cattle sacrificed and for properties not declared as foci but with cattle sacrificed due to bonding with foci, 2005 and 2006). Source: Brazil (2020).

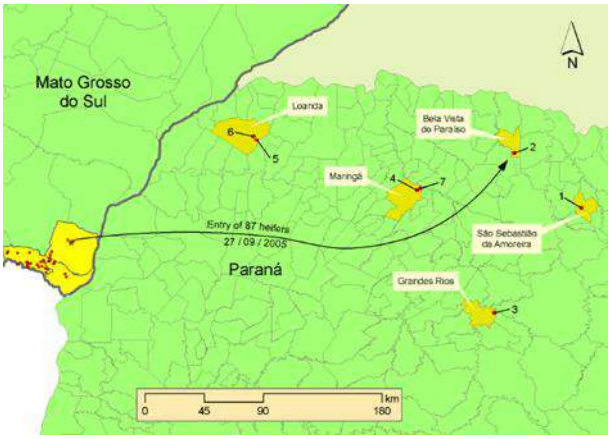


Fig. 13: Geographical representation of the foci registered in Paraná. Source: PNEFA (2008a).

According to the context presented by Brazil (2020), in the last ten years South America includes most of the

herds located in a free country or zone with or without vaccination, including with countries achieving the recognition of foot-and-mouth disease free without vaccination, in whole or in part.

e) State Agency for Animal and Plant Sanitary Defense - IAGRO

The State Agency for Animal and Plant Sanitary Defense (IAGRO), is an municipality with forum and headquarters in the Capital of the State of Mato Grosso do Sul with legal personality of public law, technical, administrative and financial autonomy, own assets, and period of indefinite duration, in accordance with the law, was created by item I of Art. 6 of Decree-Law No. 9, of January 1, 1979 (MATO GROSSO DO SUL, 1979), under the name of Department of Agricultural Inspection and Defense of Mato Grosso do Sul (IAGRO), and its name changed to the State Agency for Animal and Plant Sanitary Defense by point "a" of item III of article 83 of State Law No. 2,152, of October 26, 2000 (MATO GROSSO DO SUL, 2000). IAGRO is bound by the State Secretariat of Environment, Economic Development, Production and Family Agriculture (SEMAGRO) and supervised by it, pursuant to Law No. 4,640of December 24, 2014, and its amendments (MATO GROSSO DO SUL, 2014).

IAGRO is invested by an agricultural defense authority of the State of Mato Grosso do Sul and is responsible for ensuring the supply of quality animal and plant products to the population, through defense and agricultural inspection, operating in the promotion of public health, preservation of the environment and ensuring access to agricultural products to consumer markets. The agency is also responsible for complying with the operational obligations delegated by the Executive Branch, which deals with legislation related to the protection of animal and plant health and the control and inspection of agricultural products, goods and services, processes and technologies achieved by the agricultural health care system, being assured the other prerogatives necessary for the proper exercise of its duties (MATO GROSSO DO SUL, 2020).

IAGRO's basic organizational structure for the performance of its duties is divided hierarchically into a Superior Collegiate Decision-Making Body represented by the Board of Directors, which is responsible for the main resolutions and strategic decisions of the municipality, the Superior Management Board represented by the Board of Directors of the Presidency, which is composed of the Chief Executive Officer and the Deputy Director, and its responsibilities are to manage the resources and general operations, acting as the central point of communication between the operational and the board of directors, and it is up to the Chief Executive Officer to determine the strategic direction and ensure that the objectives are implemented through functional steps. Below the Superior Management Body is the Collegiate Body of Senior Management represented by the Board of Directors, which is composed of the Chief Executive Officer, Deputy Director and Managers who approve IAGRO's annual work plan. Directly linked to the Superior Management Management Body are the Superior and Direct Advisory Bodies represented by the Quality Management System Coordination; Coordination of Development and Strategic Management: Legal Attorney and Intelligence Coordination. Following the hierarchy below are the Superior Management Bodies and subordinate units being the managements with end activity the Management of Inspection and Animal Sanitary Defense composed of the Division of Animal Sanitary Defense and the Division of Inspection of Animal Products, Management of Inspection and Plant Sanitary Defense composed by the Division of Plant Sanitary Defense, Division of Agricultural Products and Materials and Division of Inspection and Classification of Products of Plant Origin, Laboratory Management composed of the Division of Laboratory of Animal Disease Diagnostics and Food Analysis, Division of Laboratories of Analysis of Official Seeds and Laboratory Division of Laboratory of Soil Analysis and Agricultural Corrective, Management of Control and Operations composed Division of Epidemiology, Division of Sanitary Education, Division of Execution of Infraction and Fine And Agricultural Traffic Division and management with activity through Administration and Finance Management composed of the Administration Division, Accounting, Budget and Finance Division, Human Resources Division, Information Technology Division and Transport Division. Finally, there are the Operational Execution Units represented by the Regional Units and Local Units (MATO GROSSO DO SUL, 2020).

f) Critical control points for reintroduction of foot-and-mouth disease virus by animal health defense in the state of Mato Grosso do Sul

In the context of the epidemiology of foot-and-mouth disease and analyzing the characteristics of the virus in the environment, it is estimated that the movement of animals creates an important risk of spreading the disease. The commercial movement of cattle enables the virus to remain in the environment and production structures can favor conditions for the maintenance of viral circulation, characterizing these areas as endemic areas that become

"suppliers" or providers of viruses to other regions (HUGE, 2011). Thus, animal traffic is one of the critical control points of Foot-and-mouth Disease in Mato Grosso do Sul, and should be closely monitored.

People also represent an important factor of analysis in the epidemiology of Foot-and-mouth disease, because when they come into contact with infected animals they are exposed to large amounts of viruses, the volumes of air sampled in a period of 30 minutes in a facility with infected animals have values such as 10 million infecting units. People in these conditions can be an efficient mechanical vector of foot-and-mouth disease virus and therefore anyone who has had contact with infected or potentially infected animals or carcasses should take strict biosafety measures to prevent the spread of the virus (HUGE, 2011).

A really important point to be addressed in the epidemiology of the disease is that the real importance of human action in the foci of Foot-and-Mouth Disease consists in the involvement of people in the mechanical transmission of the virus, predisposing to the dissemination of this agent to susceptible animals, either by contaminated clothing, footwear or hands, or even in the upper respiratory tract, since the virus exhibits resistance characteristics and remaining in the environment for weeks (HUGE, 2011).

The geographical distribution of the last outbreaks of the disease demonstrated that all events have occurred in border areas, which, together with the characteristic of non-aerial dissemination of Foot-and-Mouth Disease, marks the importance of the work of partnerships between neighboring countries in these areas. As a priority, mercosur has established the implementation of combined health actions in the border regions between the countries of Argentina, Bolivia, Brazil and Paraguay, promoting the continuity of national programs for the eradication of AF and other regional actions and strategies capable of identifying possible primary sources of infection, with the aim of minimizing the risks of the introduction and dissemination of the virus in the region (HUGE, 2011).

The State of Mato Grosso do Sul, for its immense dry border with two countries, being paraguay and Bolivia, and taking into account the variation of values of the bovine atone between the two and the MS, which is often much lower in relation to the price practiced in the state, according to Canal Rural (2021), the price of the ox atrtoe in Mato Grosso do Sul is R$ 270.00, while in neighboring countries the price difference reached 10 dollars per arroba (Revista Globo Rural, 2021), a variation that encourages producers to risk smuggling animals without any documentation and sanitary attestations, thinking only of the profit obtained from this trade, becoming in this way the most critical control point for the reintroduction of the disease across our border, which has numerous vicinal roads connecting them.

Another important critical point of control are the events of animal agglomerations, such as auctions, exhibitions, lace parties, etc. only in the year 2021 from January to September, 524 events with animal agglomeration were held, and a total of 475,986 goats transited throughout the state to participate in these events, in addition to 160 sheep and 17 goats [18] (IAGRO,2021). In these points, the transit of animals from various units of the federation and several municipalities within the state are common, which promotes a high contact between the various species of susceptible animals, such as Cattle, Buffaloes, Goats and sheep, which greatly increases the spread of all types of diseases, including Foot-and-mouth disease.

This study has as main objective the characterization of epidemiological risks for the reintroduction of foot-and-mouth disease virus in Mato Grosso do Sul, evaluating critical control points, especially in relation to the movement of cattle in the border regions with Paraguay and Bolivia.

II. MATERIALS AND METHODS

a) Research Design

This work regarding its research nature has a qualitative and quantitative approach since it will require statistical methods and techniques through data collection of IAGRO systems (PRODANOV and FREITAS, 2013).

The research was carried out through a bibliographic study endorsed in this article, we used data from the IAGRO of transit and movement of animals from the risk region and critical control points, mainly from the international border region, as well as actions developed in the areas of study.

Highlighted by a research in the exploratory and explanatory form, which provided a greater proximity to the problem, and identified the factors that determine or contribute to the occurrence of the facts (GIL, 2008).

b) IAGRO data collection

Data were collected from the e-Saniagro system, the system responsible for all control of animal stock, registration of producers and properties, control of all animal movements through e-GTAs, agricultural events, veterinary prescriptions for brucellosis vaccination, control of stock of vaccines in resales, controls all Infraction Records and fines drawn up by the Agency's inspectors, in addition to all financial transactions related to the fees and fines imposed. All verification of the data present in this database is analyzed by a BI (Business Intelligence) system that generates reports of movements, controls and irregularities that generate demands for traffic and property inspection teams. All producers in the state have access to this system where they make the declaration of vaccination of animals, issue Animal Transit Guides - GTA and perform the adjustment of stock of animals of their property.

c) Cattle movement network and heat map

The networks of cattle movements are generated from analyses made by the BI System in our e-Saniagro database, taking into account all gtas (Animal Traffic Guides) emissions in the state, characterizing the properties of origin and destination.

The heat map took into account the entire balance of animals and the geographical coordinates of all producers and health records registered in our e-Saniagro System.

III. RESULTS AND DISCUSSION

In 2021, 334,578 Animal Transit Guides (GTAs) were issued in Mato Grosso do Sul, by IAGRO throughout the state, characterizing the municipalities that moved cattle and buffaloes the most were: Corumbá, Campo Grande, Ribas do Rio Pardo, Paranaíba, Aquidauana, Rio Verde de Mato Grosso, Coxim and Porto Murtinho, [18](IAGRO,2021) as shown in the animal movement map below.

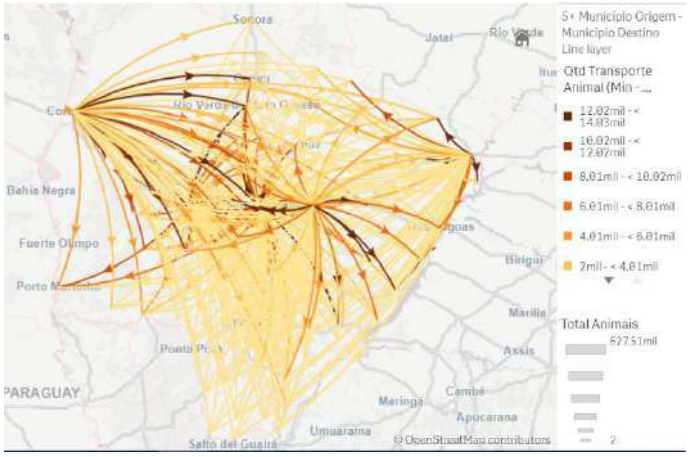
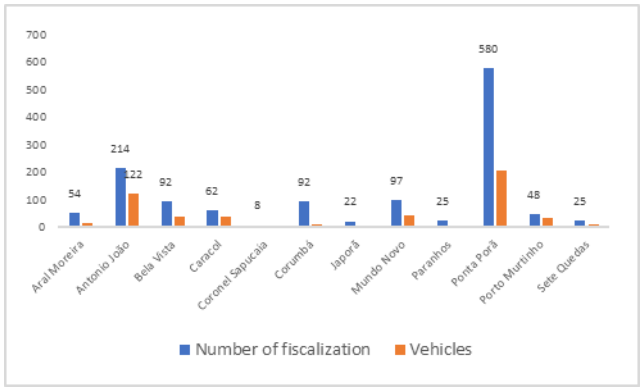


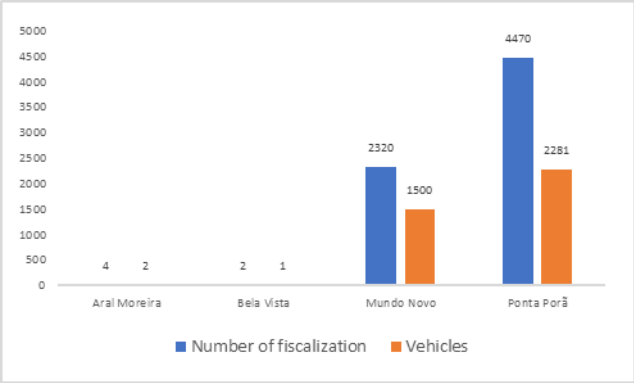
Fig. 14: Cattle movement in the state of Mato Grosso do Sul in 2021. [18]

a) Traffic control in border regions.

The traffic control of animals, their products and by-products carried out in the border region with neighboring countries is carried out from a monthly report issued by the e-Saniagro system, which identifies properties with suspicious movements, generating a list of places with high probability of irregular traffic. From this report, the steering wheel inspection teams are designated for the border regions, generating numerous inspections and infractions, and even sanitary slaughters of cattle and equidae that had no origin. According to the chart below, in 2021 alone, 1,319 steering wheel inspections and 6,796 inspections were carried out at fixed posts in the border region, covering a number of 4,312 vehicles.

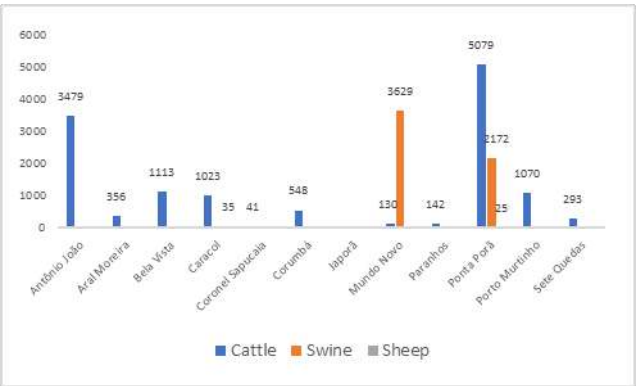


Graph 01: Number of inspections and vehicles approached by border municipality by steering wheel inspection teams in 2021 (IAGRO,2021)

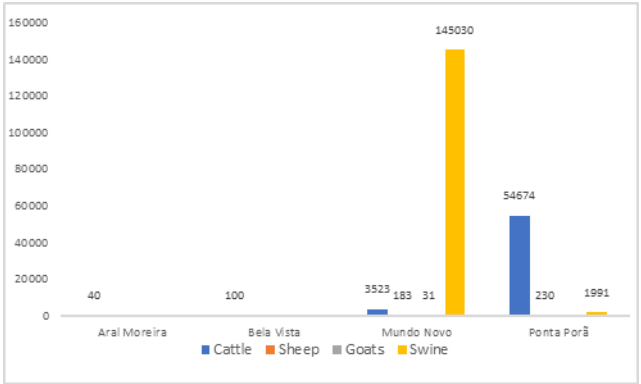


Graph 02: Number of Vehicles and inspections at fixed stations in the international border regions in 2021. (IAGRO,2021)

In these inspections, 71,611 bovídeos, 152,822 pigs and 473 sheep were surveyed (Graph 03 and Graph 04).

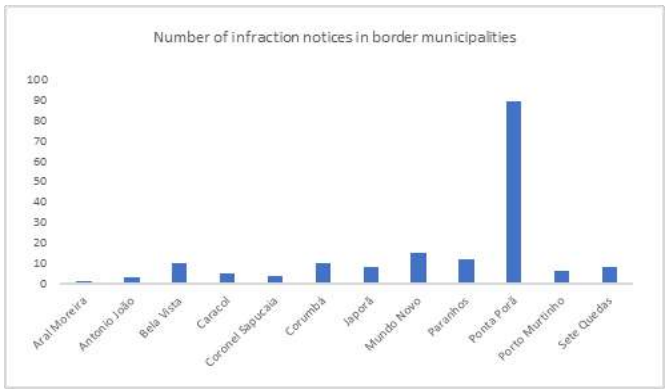


Graph 03: Number of animals inspected by the steering teams at the border by species in 2021 [18].



Graph 04: Number of animals inspected at fixed posts in border municipalities per species in 2021 [18].

All these inspections of vehicles carrying animals generated a quantity of 171 Infraction and Fine Notices in all 12 municipalities of the international border, only in the year 2021, divided according to graph 05.

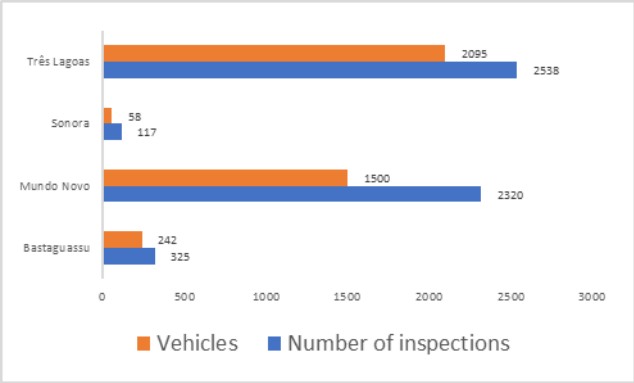


Graph 05: Number of Infraction Notices per border municipality drawn up by inspection teams in 2021 [18].

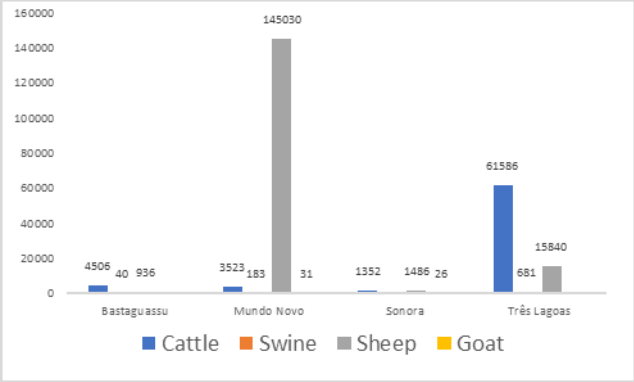
IAGRO currently has 4 vessels that are used in the control of animal transit in rivers, mainly in the borders and regions of the Pantanal, the vessels allow in each one that the actions are carried out by up to 6 servers, which allows the performance of irregular traffic control actions of cattle in these regions, the servers that act in river inspections, receive periodic training with the Brazilian Navy [18].

b) Traffic control in interstate currency regions.

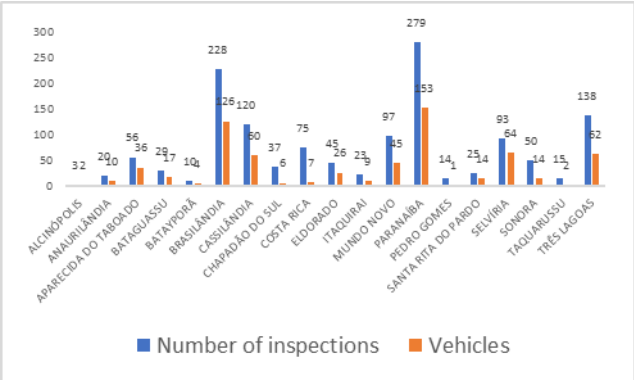
The traffic control carried out in the borders of the state of Mato Grosso do Sul, with the neighboring states being, Mato Grosso, Goiás, Minas Gerais, São Paulo and Paraná, take place in fixed inspection posts and teams of Volantes, where the posts serve as a support point for the teams that carry out the inspection throughout the entire length of the border with the neighboring states. All the survey of the movements were made from the existing data in the e-saniagro system, related to the emission of GTAs (Animal Traffic Guides), indexing the networks of movements and possible irregularities, which bases the destination of the steering wheels and the places of operation, as graph 06 attached below, where the amounts of inspections are available, the number of vehicles covered.



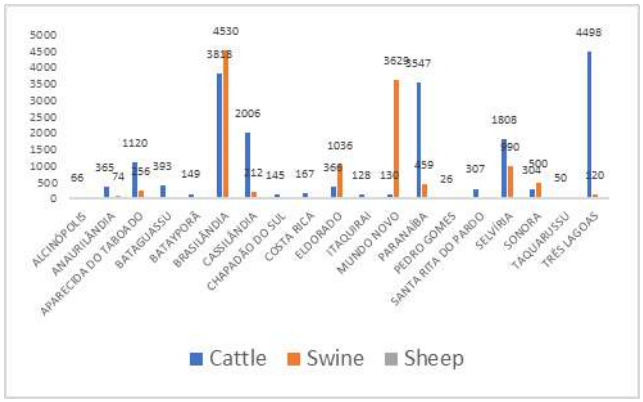
Graph 06: Number of inspections and vehicles surveyed at interstate currency stations in 2021 [18].



Graph 07: Number of animals surveyed at fixed interstate currency stations in 2021 [18].



Graph 08: Number of inspections and vehicles inspected in municipalities of interstate currency by steering wheel inspection teams in 2021 [18].



Graph 09: Number of animals surveyed by steering wheel inspection teams in municipalities of interstate currency in 2021 [18].

c) Cattle population in border regions.

The border region of the state of Mato Grosso do Sul with neighboring countries currently has 3,394,910 cattle and 6,380 buffaloes divided into 12 municipalities, according to data extracted from the e-Saniagro System. The map below characterizes the main sites with bovídeos, where red indicates the highest concentration and blue the lowest concentration. According to Figure 06.

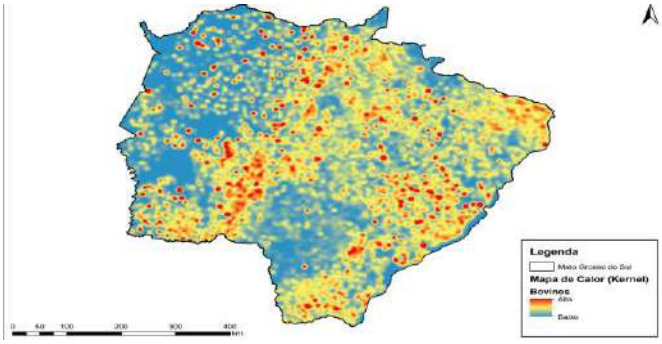


Fig. 15: Cattle Heat Map in Mato Grosso of Sul state [18].

Based on the heat map, we were able to identify the municipalities with the highest number of animals per area, being an important indicator, because if we consider only the data of the amount of animals per municipality, we would not place the municipality of Japorã as a place with a large concentration of goats in the State.

This data is very important for the decision-making of the destinations of the fly-wheel inspections, based on animal movements and in the places with the highest concentration of cattle in the state.

d) Maps of bovine movement networks

Based on the information contained in our e-saniagro systems and analyzed by BI (Business Intelligence), were issued from January 1, 2021 to the present day, 38,526 Animal Transit Guides (GTA), having as origin the border municipalities of Mato Grosso do Sul with neighboring countries, being Corumbá as the largest emitter with 12,859 GTAs followed by Porto Murtinho with 5,854 GTAs and Bela Vista with 5,691 GTAs, transiting with 644,880, 235,510 and 156,970 bovídeos respectively, with main destinations the municipalities of Campo Grande, Rio Verde de Mato Grosso and Aquidauana, as shown in Figure 07 of movement below.

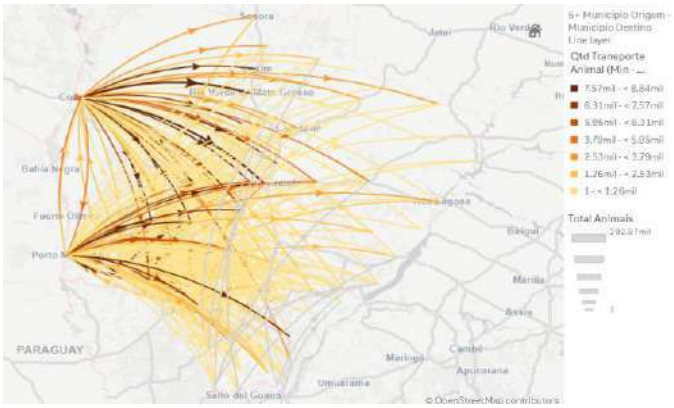
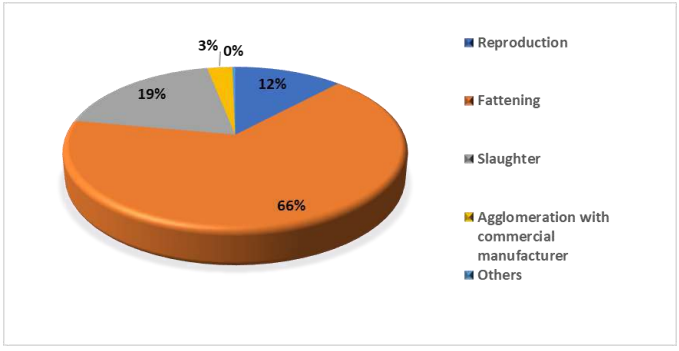


Fig. 16: Movements with origin in municipalities with international border. (IAGRO,2021)

Taking into account the purpose of the movement, the 12 municipalities of the border moved to fatten 934,650 animals, the second as slaughter being the total of 269,400 bovídeos and the third with Reproduction, moving 170,670 heads. graph 10 below.



Graph 10: Purpose of movements of border municipalities [18].

If we consider only the animals that leave the municipalities of the border to establishments for the purpose of agglomeration, we have a quantity of 1,031 GTAs, covering a quantity of 39,880 bovídeos, being again the municipality of Corumbá the largest emitter with 33,740 animals, followed by Porto Murtinho and Ponta Porã, with 2,580 and 1,520 animals respectively. As shown in Figure 08 of movement below.

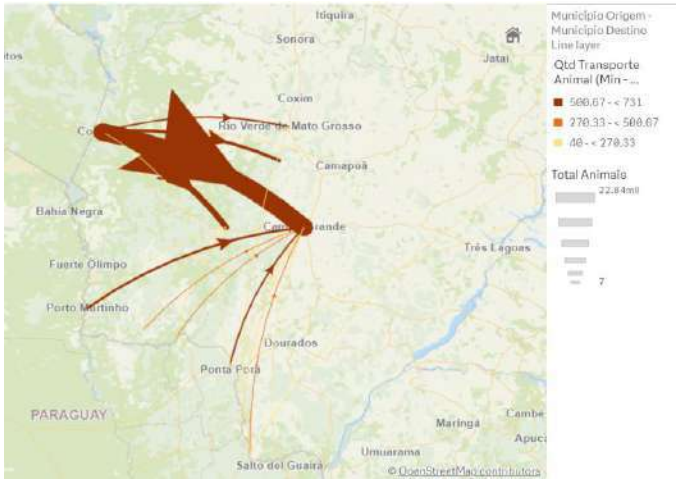


Fig. 17 - Movements with origin in the international border and destination agglomeration events [18].

The municipalities that receive these animals the most for events with agglomeration in 2021 are, Campo Grande, followed by Aquidauana and Rio Negro, totaling 37,907 bovídeos only for these 3 municipalities.

If we consider that the movement of bovídeos in the state is a risk for the reintroduction of diseases, followed by the international frontier and agglomeration events, we can consider this network of movement of animals as the most risky for Foot-and-mouth disease in the State of Mato Grosso do Sul, being very important the control of this traffic to mitigate the health risks arising from this traffic.

Having this analysis as a basis, constant inspections are carried out in the border region, where the steering wheel inspection teams have fixed posts as a support base and move throughout the international border, where we carry out the verification of animals transported regularly, that is, with all the necessary sanitary documentation, and irregular movements, which trigger numerous other health control actions, as herd counts and even sanitary slaughter.

The map below shows the points where steering wheel and fixed posts were carried out throughout the state of Mato Grosso do Sul only in the period from August 1,

2021 to October 18, 2021, where 5258 inspections were carried out.

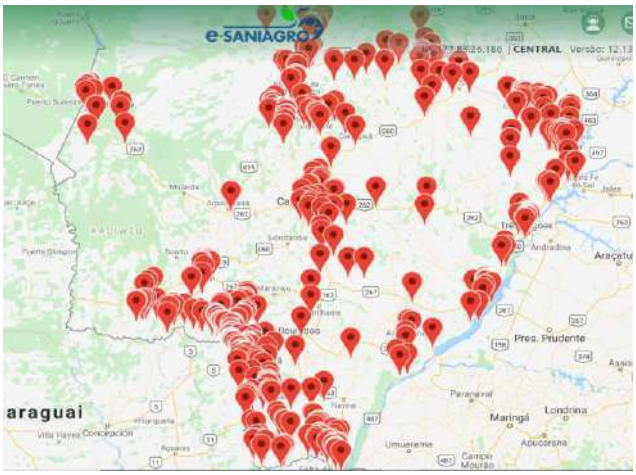
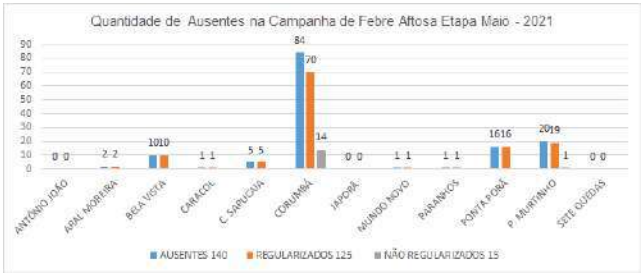


Fig. 18: Traffic inspections occurred in the state in the period from 01/08/21 to 18/10/21 totaling 5273 Inspection Reports [18].

e) Regularization of properties absent from foot-and-mouth disease vaccination

According to updated data from the last vaccination campaign against foot-and-mouth disease in may 2021, the 12 municipalities with international border had an amount of 140 properties absent from vaccination, according to graph 07.



Graph 11: Absent vaccination in the municipalities of the border May/21 [18].

According to the image above, 125 properties were regularized, leaving 15 establishments still without regularization, it is worth noting that these 14 properties are in the municipality of Corumbá, in places of difficult access, where not even with the support of a state plane was possible to carry out regularization, being necessary the support of a helicopter of the Military Police, however this aircraft is under maintenance, and as soon as possible will be used to assist the teams in order to zero the list of absentees, and 1 property is located in the municipality of Porto Murtinho, where vaccination began accompanied by the inspectors of IAGRO, and could not finish yet due to a judicial issue. Forty-five infringement notices for non-vaccination against foot-and-mouth disease and 34 Infraction Notices were drawn up for lack of vaccine registration [18].

IV. CONCLUSION

Cattle ranching in the state of Mato Grosso do Sul directly and indirectly generates approximately 38,317,000 jobs and moves R$ 24 billion annually, and this financial movement has increased by 18.2% per year, contributing to the state's GDP being R$ 23.5 billion.

With the advance to a status of Free Of Aftosa without Vaccination, the health defense service of Mato Grosso do Sul is undergoing changes, where the withdrawal of vaccination should be replaced by actions that strengthen health surveillance, among them, the supervision of animal traffic, which reflects the need for an increase in the structure of animal traffic inspection, products and by-products, in meeting the new model of surveillance in properties, in the performance of fixed posts and steering barriers, strengthening in sanitary education with producers, with prioritization in risk areas with a surveillance system capable of detecting a outbreak of foot-and-mouth disease as soon as possible.

Among our challenges are the international lines with Paraguay and Bolivia, which together have more than 1,500 km of border, and pass through 12 municipalities, in addition to the Pantanal, where we have large properties with difficulties in accessing and managing herds, we also have a very large number of settlements and indigenous villages, which are places more susceptible to the illegal movement of animals and products, and greater direct contact between animals, and agglomeration of people and properties.

All this inspection process for the year 2022 IAGRO will be able to count on the support of 2 aircraft (an airplane and a helicopter), which will optimize the control actions, especially in properties difficult to access in the Pantanal and other regions of the state that are necessary, including the support of 22 state-of-the-art drones.

One of the most important means of transmission of diseases, is linked to the transit of animals, products and by-products, for this, IAGRO has intensified as shown in Figure 09, and it is intended to further intensify

inspections, with the aim of curbing the movement of animals, products and irregular by-products.

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The Importance of Stock Registration in Beef Cattle Management, for Managerial Control in the Breeding, Rearing and Fattening Phases: A Case Study in a Small Farm "alpha", in the Southern Cone of Rondônia / Brazil.

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***Keywords*— Stock register, Custobov, Beef cattle, Small property**

Abstract*—*Beef cattle raising is a branch of agribusiness activity carried out by cattle raisers or livestock breeders, with cattle raising one of the largest branches of Brazilian agribusiness. The generation of new technologies leads to growth year after year, especially of large properties that use the improvements in order to achieve their growth. According to Brasília (2020, p. 60): "the growth forecast between 2019/2020 and 2029/2030 in the beef segment is a variation of 16.2% (thousand/t). According to the IBGE that year, 32.4 million heads were slaughtered across the country", base year 2019. The case study and participant survey were used as a methodology. The typology in relation to the problem was qualitative. The issue listed was: What is the best way to demonstrate and value the breeding phases, breed and fatten beef cattle The general objective of this research is to show what is the best way to measure the creation phases (rearing, growing and fattening), in the stock control records, in agribusiness specifically for beef cattle in small properties. As a result, we highlight that the spreadsheet made available

by EMBRAPA was completed, according to Costa et. al. (2017), in Excel 'Custobov', which provided the administrative and management controls for inventory control.

I. INTRODUCTION

The research carried out had the intention of equipping ranchers in decision making about stock control, for small producers, which can also be adopted by medium and large breeders.

The target focus of this work were cattle raisers, who live on their rural properties, and work to ensure their livelihood and transform the surplus production into income, that is, the small producer and producer of beef cattle.

Inventory controls were demonstrated using the Excel spreadsheet 'Custobov', made available by the Brazilian Agricultural Production Company - EMBRAPA, according to Costa et. al. (2017), highlighting the cattle stock control form, reports and graphs, which will be presented in the research results section.

In agribusiness, these controls, in addition to administrative knowledge, are important, in the specific case of handling beef cattle, technical knowledge of management and specific knowledge of stock control.

In the development of the research, the following question-problem was formulated: **What is the best way to demonstrate and value the stages of raising, rearing and fattening beef cattle?**

The research had the following **general objective**: To show what is the best way to measure the creation phases (rearing, growing and fattening), in the stock control records, in the specific agribusiness of beef cattle in small properties.

To answer the general objective, the **following specific objectives**were listed**:**a) To carry out a bibliographical review regarding the subject to be studied. b) Describe the brood phases (reproduction, nutrition and weaning of the calf). Breeding Phase (Weaning until the beginning of fattening in males or until reproduction in females). c) Identify a model for recording the stock control of the breeding, rearing and fattening stages of beef cattle.

The research carried out, having as **methodology**the bibliographical research, which were used as a source of consultations, magazines, books, periodicals among others on the subject under study.

In addition, the researcher participated in data collection by recording field observation data and using specific documents on a cattle farm, which is the Nelore breed whose specimens are medium and large animals with white or gray fur, on a small property, thus being a case study.

According to Gil (1999, p.73) *apud*Beuren (2003 p. 84):

> The case study is characterized by the deep and exhaustive study of one or a few objects, in order to allow ample and detailed knowledge of the same, a task practically impossible due to the other types of delineations considered.

The case study was carried out on a single farm and concentrated, due to the accessibility of information and permission to monitor the handling of beef cattle.

The research carried out was qualitative and according to Beuren, (2003 p.92): “In qualitative research, deeper analyzes are conceived in relation to the phenomenon being studied”.

This research is classified, in terms of typology, as participant and descriptive and according to Beuren (2003 p. 90) describing that participant research is characterized by the situations to be studied: “Within this context, it is important to promote the participation of all, diving deeply in research”.

The work is structured in the literature review on beef cattle, the livestock phases (raising, rearing and fattening), the stock record of beef cattle management, and the adoption of the 'Custobov' spreadsheet, provided free of charge by EMBRAPA to demonstrate the calculations.

II. THEORETICAL REFERENCE

2.1 Beef cattle ranching.

Livestock moves in rural areas and its development depends on investments by owners and access to credits for rural producers, including for small properties, in order to maintain, expand and fund beef cattle agribusiness, being an important factor in generating income for the ranchers.

LazzariniNeto (2000), states that livestock is surprising in Brazil, and that no other activity in the field currently presents potential for growth and generation of income and foreign exchange as the production of beef.

The cattle herd in the state of Rondônia is expected to reach 14 million heads in 2017, according to (IDARON – Agrosilvopastoral health defense agency of the state of Rondônia).

Following the steps for managing beef cattle raising, we present the flowchart for managing cattle. According to Oliveira *et al.* (2006, p.5), "the management and zootechnical bookkeeping in order to have full control of the production system and the costs involved in production in order to manage resources and estimate profits, as well as carry out the meta-evaluation of the process administrative", according to the flowchart shown in Figure 1.

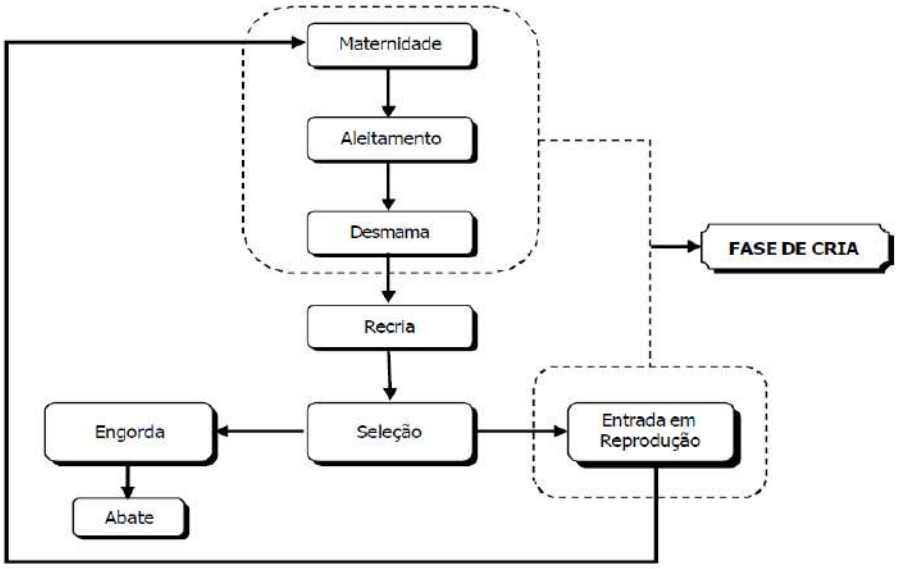


Fig.1: Flowchart of a property dedicated to raising, rearing and fattening beef cattle.

Source: Oliveira et al. (2006, page 6)

It is of paramount importance to maintain management controls and mainly inventory for control in phase described in the flowchart above.

In the projections 2019/2020 to 2029/2030, made by MAPA - Ministry of Agriculture, Livestock and Supply, in 2020, the participation of beef by region is illustrated, which we present in figures 2 and 3 below.

BOVINOS	Animais abatidos 2019 (cabeças)	%
Produção Nacional	32.436.451	100
Principais estados produtores		
Mato Grosso - MT	5.649.896	17,4
Mato Grosso do Sul - MS	3.585.067	11,1
São Paulo - SP	3.326.168	10,3
Goiás - GO	3.008.205	9,3
Minas Gerais - MG	2.846.455	8,8
Pará - PA	2.407.912	7,4
Rondônia - RO	2.392.309	7,4
Rio Grande do Sul - RS	1.966.444	6,1
Total	25.182.456	77,6

Fonte: IBGE - Pesquisa trimestral de abates de animais (Acumulado Jan a Dez 2019)

Fig.2: Main states in slaughtered animals - CATTLE in 2019 - National

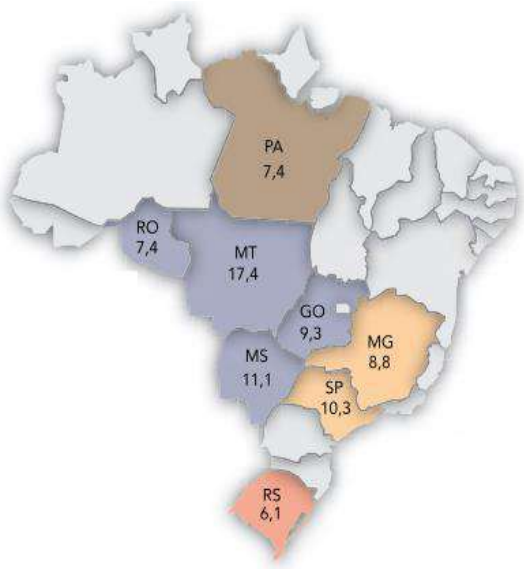


Fig.3: Main states in slaughtered animals - CATTLE in 2019 - National - MAPA BRAZIL DISTRIBUTION.

As can be seen in the state of Rondônia, in 2019 it contributed with 7.4% of the cattle slaughtered in 2019, being highly representative at the national level.

2.2 brood phase.

According to Valle, Ezequiel Rodrigues Do. (2000, p.50) apud Longo (2014, p. 20): "The productivity of the

breeding system depends on the minimum knowledge of the factors involved in the production process, the level of management, the management techniques used and the availability of resources financial".

The brood system enters as the first phase of the process of a beef cattle, from its reproduction, its nutrition, cure of possible parasites, which often leads to the death of the calf, due to the lack of necessary techniques for this, and to put the end of weaning, the correct period for this procedure, freeing for re-creating.

The correct management of all the processes leads to better formation of the cattle on top of the factors generated during this period, as shown in figures 4, 5 and 6, with the birth, nutrition and weaning of the calf.

Fig.4.Birth of the bovine.

Source:https://www.google.com.br/search?q=nascimento+do+bovino+de+corte&source=lnms&tbm=isch&sa=X&ved=0ahUKEwje0v73_N7XAhVEfpAKHUE1AR0Q_AUICygC&biw=1366&bih=662#imgrc=GZLTZoJk5kqv2M

Right after birth, the mother is in charge of cleaning the calf, removing all the birth mucosa, and in the same way already massaging the calf, which is an important part, in the same way the cure of the navel of the animal, done by the cattleman. Some offspring are rejected by the matrix, making it more difficult to correctly control the newborn. Afterwards, the newborn is observed in its period of nutrition and growth.

Fig.5.Calf Nutrition.

Source:https://www.google.com.br/search?q=nascimento+do+bovino+de+corte&source=lnms&tbm=isch&sa=X&ved=0ahUKEwje0v73_N7XAhVEfpAKHUE1AR0Q_AUICygC&biw=1366&bih=662#imgrc=evDtTdIiDW1J8M :

To avoid problems during the mother's gestation or the calf's lack of interest in nutrition (feeding), there must be a control followed by observation of the calf so that no damage occurs in the rearing, rearing and fattening process.

Fig.6.Weaning from the calf, at approximately 8 months of age.

Source:https://www.google.com.br/search?biw=1366&bih=662&tbm=isch&sa=1&ei=hSQcWo-NG8_4wASb9rT4Aw&q=bezerro+desmamado&oq=bezerro+des&gs_l=psy-ab.3.1.0l6j0i5i30k1l2j0i8i30k1l2.59096.61007.0.63340.11.10.0.1.1.0.216.1182.0j5j2.7.0....0...1c.1.64.psy-ab..3.8.1186...0i67k1.0.xQcPAbcY1Rk#imgrc=pDoNR6KSR4xNYM:

Oliveira *et al*, (2006, p.7) states: "In general, well-managed farms keep zootechnical records, such as dates of birth, coverage, weaning, weight gain control, control of the matrix's body score, sanitary problems etc".

The control of handling or phases of the cattle is of paramount importance and must be carried out by the farmer, with follow-up reports being made in the phases mentioned above.

- Rebuildphase.

In the rearing phase, males and females are separated for better stock control, with a breeding season for females in 36 months, where the females can be bred during this period, after which they are removed for slaughter , where the males are separated for the fattening phase.

According to Corrêa et al, (2009, p.8):

> As for rearing, it is a phase of bovine development in which it presents greater impetus for body growth. It is between weaning and the beginning of fattening. This phase is characterized by the great formation of muscle mass and the development of bone structure. At the end of this phase, the bovine will have a fully formed skeleton and its body size will be defined.

Figure 7 shows the animals separated for breeding, and Figure 8 animals destined for the fattening stage.

Fig.7. Cattle intended for breeding.

Source: https://www.google.com.br/search?biw=1366&bih=662&tbm=isch&sa=1&ei=xiQcWvi7EpCuwgT10aPADA&q=bovinos+reprodu%C3%A7%C3%A3o&oq=bovinos+reprodu%C3%A7%C3%A3o&gs_l=psy-ab.3..0i8i30k1l2.46471.50330.0.50499.18.17.0.0.0.0.280.2215.0j11j2.13.0....0...1c.1.64.psy-ab..5.13.2211...0j0i67k1j0i5i30k1j0i30k1.0.6UEMbN_THME#imgrc=jcwq_ghO7A9CcM:

Fig.8.Cattle separated for the fattening phase.

Source:https://www.google.com.br/search?biw=1366&bih=613&tbm=isch&sa=1&ei=SQcWqL9NsbAwATwjbrwBA&q=cattle+fattener&oq=cattle+fattener&gs_l=psy-ab.3. .1.0.0.0.204.1474.0j8j1.9.0....0...1c.1.64.psy-ab..7.9.1274...0j0i67k1j0i30k1j0i8i30k1j0i24k1.0.HF7XfnvVVYE#imgrc=5jlfMgYcD7-xqM:

At this stage, breeders are expected to adopt the inventory control form in addition to other cost and expense controls.

- Fatteningphase.

The fattening phase is the last of the processes for the release of the bovine for the cut, after going through all the brooding and rearing phases, the bovine is separated for relatively enough fattening for its slaughter.

For Sewell (2002, p. 135) *apud*Corrêa et al.(2009 p. 9)

> This fattening phase is divided into two phases: the fattening phase itself, where the animals are gaining weight due to the deposition of muscle tissue, and the finishing or finishing phase, where the animals slow down the meat

deposition and start to depositing fat, promoting the finishing of the carcass. In this case, food has a great influence and must be administered with care so as not to cause high costs to the rancher and low results in the fattening phase.

After reaching their final weight, they are sold quickly so that there is no harm to the breeder due to the cost of accumulating fat in the cattle carcass for cutting.

Beef cattle raising generates a lot on top of fattening, ranchers see in this system a better and faster way to have a financial return, since lean and cheap cattle are bought by the weight of the arroba, and fattened quickly with about 460 kg to be taken to slaughter, a faster cycle, considering that this property does not make use of animal reproduction, putting into practice and values the stages of growth and generation of cattle.

Figure 9 shows the last stage of beef cattle.

Fig.9.Cattle being sent for slaughter and sale.

Source:https://www.google.com.br/search?biw=1366&bih=662&tbm=isch&sa=1&ei=NyccWueKJcuowgTU5IioCg&q=cattle+referred+for+slaughter&oq=cattle+referred+for+o+labate&gab.3...2783.11468.0.11628.46.36.4.0.0.0.342.4465.0j19j5j1.25.0....0...1c.1.64.psy-ab..19.6.736...0j0i13k1j0i30k1j0i8i30k1j0i10i24k1j0i24k1.0.saaqj#wqK imgrc=HXKaGd8-SL4R6M

- Beef cattle management stock record.

According to Barbalho et al. (2005, p.3): “To facilitate management (models that apply in cattle raising, such as feeding, reproduction, vaccination, weight gain, pasture movement, change of era) it is necessary to divide or classify the herd into categories”.

The management of cattle is a process that entails several factors in a rural property, from the beginning of the phase to the end, every strict control must be maintained for the best monitoring of its stock.

According to Marion (1996, p. 49) apudBarbalho et al. (2005 p. 3):

1. Calf: is the calf of the cow. Its age ranges from zero to 12 months of age. 2. Calf (a): it is the name given to the calf (a), after the weaning period. The age of the heifer is from 13 months until slaughter and that of the heifer is from 13 months until the first calving. 3. Garrote: entire male (not neutered) from weaning to entry into reproduction. 4. Bull: The withers changes to the bull category around two to three years after birth, where in this last year it undergoes experimentation, it is recommended that the permanence in the herd does not exceed the range of three to four years. The era of the bull starts in the 25th to the 35th month, as long as he has a good performance as a sire. If it does not perform well, it remains in the withers category, where it will be discarded (slaughter) or passes to the ox category. 5. Ox: adult cattle over three years old, fort and tame, can be used in agricultural services. 6. Cow: is the name given to the heifer after the first calving. Like the bull, the cow goes through a period of experimentation and the

measure that proves to be a good breeding matrix remains in the herd, otherwise it is discarded.

This stock and handling control is represented by conference sheets so that there is no loss of control. The sheets are separated according to planning.

- Flock Form: To monthly control the herd, with daily monitoring, recording the stock, purchase for inputs for the property, even for recording deaths that may happen in the controlled lot. Based on IDARON file.
- Cattle Purchase and Sale Form: Controls the purchase and sale of cattle with their values, weights, freights. According to sales and purchase invoices.
- Management sheet: Assists in the management carried out in the herd.
- Birth record: Controls the birth of calves, their date, matrix and sex stamps. The value being registered according to the market price.
- Matrix control form: Controls the reproduction of cows, the months of gestation, and weaning of the calf, together with the birth form with the control of calving and mating dates.
- Pasture sheet: Controls pastures with a correct management of cattle, checking the acquisition of lot weights and pasture quality. This pasture management takes place in paddocks formed on the property to control pasture growth, helping during rainy periods, as it is a pasture with a sawed area and not red earth, being in an open and unconfined field, it needs greater care in this area. control of pastures so that there is no greater damage or loss of weight in the animals, resulting in a loss of price for a possible sale.

Lack of control, or sufficient knowledge of ranchers, leads to difficulties in managing stocks or decisions to be taken on the property to generate profits.New technologies most often facilitate harm by not knowing their actions. Smaller properties tend to keep your records more easily, larger scale properties make your control a daily use of the supplied instruments, thus giving your controls and P&L checks.

III. RESULTS AND INTERPRETATIONS

The research was carried out in a small property, in the Southern Cone of Rondônia, which was named in this study as 'Alpha', with data from the year 2020.

The stock control model used was the Excel spreadsheet 'Custobov', from EMBRAPA, available at https://www.ilovepdf.com/pt/pdf

The 'Custobov', in addition to the spreadsheets below, comprises a manual prepared by a team of authors, who are researchers and analysts from EmbrapaGado de Corte, explaining the concepts of each topic and how to use the Excel spreadsheet.

We will present below the result of the accounting records using EMBRAPA's Excel model.

In figure 10, spreadsheet 1 is presented. Cattle of the year, there are the data of the batch under study, that is, the stock record.

1 **REBANHO BOVINO DO ANO**

Atenção: Preencher somente as células brancas.

1. REBANHO DE REPRODUÇÃO

	Peso médio	Valor	Cabeças		Peso vivo total do rebanho (kg)		Valor estoque gado (R$)	
	kg/cab.	/cab.	Inicial	Final	Inicial	Final	Inicial	Final
Touros	450	6,000,00	2		900	900	12,000,00	12,000,00
Vacas (matrizes)	240	3,680,00	19		4,560	3,360	69,920,00	51,520,00
SUBTOTAL			21		5,460	4,260	81,920,00	63,520,00
DIFERENÇA NO ESTOQUE E VALOR DO GADO DE CRIA (final - inicial)						-1,200		-

2. REBANHO DE RECRIA / ENGORDA

	Peso por cabeça (kg)			Valor	Cabeças		Peso vivo total do rebanho (kg)		Valor estoque gado (R$)	
	inicial	final	média	R$/kg vivo	Inicial	Final	Inicial	Final	Inicial	Final
Fêmeas + 36 meses			-				-	-	-	-
Fêmeas 24-36 meses			-				-	-	-	-
Fêmeas 12-24 meses			- 73 85				- 270 280	- 1,035 -	- 17,550,00 21,000,00	- 67,275,00 -
Fêmeas 0-12 meses	30	115	-	65,00	9		-	-	-	-
Machos 0-12 meses	35	135	-	75,00	8		-	-	-	-
Machos 12-24 meses			-				-	-	-	-
Machos 24-36 meses										
Machos + 36 meses inclusive tourunos										
SUBTOTAL					17	9	550	1,035	38,550,00	67,275,00
DIFERENÇA NO ESTOQUE E VALOR DO GADO DE RECRIA / ENGORDA								485		28,725,00

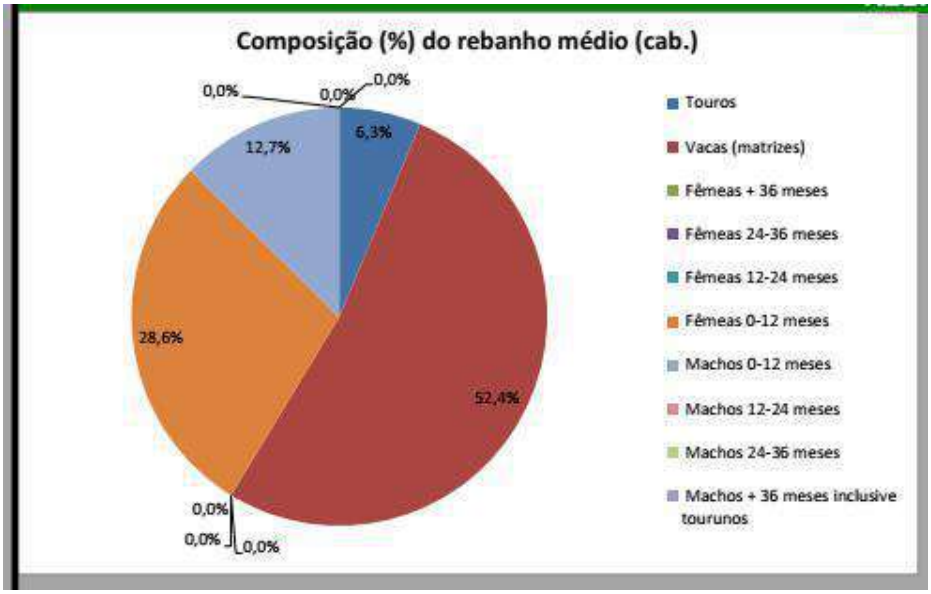
Fig.10: Worksheet 1. Cattle of the year.

Source: Prepared by the authors. 'Custobov' spreadsheet base.

As can be seen, in addition to the number of heads, the model presents the weight and value.

The stock control form is an extremely important aid for a beef cattle rural property, its use gradually facilitates all decision-making by ranchers.

The 'Custobov' spreadsheet also provides graphs that are made directly from the data entered in the model. Below we present Graph 1, on the composition (%) of the average herd (head).



Graph 1– Composition (%) of the average herd (head).

Source: Prepared through data entered by the authors.'Custobov' spreadsheet base.

The template also provides the following graphics:

a. Composition (%) of the average herd (AU) by stage.
b. Average herd value by animal category (R$).
c. Herd balance (kg live weight).

The table and graphs are the records of the breeding/rearing and fattening operation on the rural property, with an initial herd of 2 bulls and 19 cows (matrices - grafted), weighing the bulls in 450 kg or 30 arrobas (@), with a value of BRL 6,000 each, totaling BRL 12,000.00.

The 19 cows with an average weight of 240 kg or 16@, in the amount of R$ 3,680.00 (Market value) totaling R$ 69,920.00. The initial value of the herd is R$ 81,920.00. Where of the 19 heads of cows, 17 had correct brood, 9 females and 8 males were born, with an average initial weight of females of 30 kg with a value of R$ 65.00 per kg, and males 35 kg with a value of R$ 75.00 per kg, totaling BRL 38,550.00 of births. Having a total herd of 38 heads, in the amount of R$ 120,470.00, as the initial balance, as shown in the figure.

The quantities recorded are real from a beef cattle farm in the Southern Cone of Rondônia. The values used were from the market (refrigerators and butchers).

Percentage analyzes (%) are also available, as shown in Figure 9, where we present spreadsheet 5, Figure 11 – Herd report (averages of the year).

5 RELATÓRIO DO REBANHO (médias do ano)

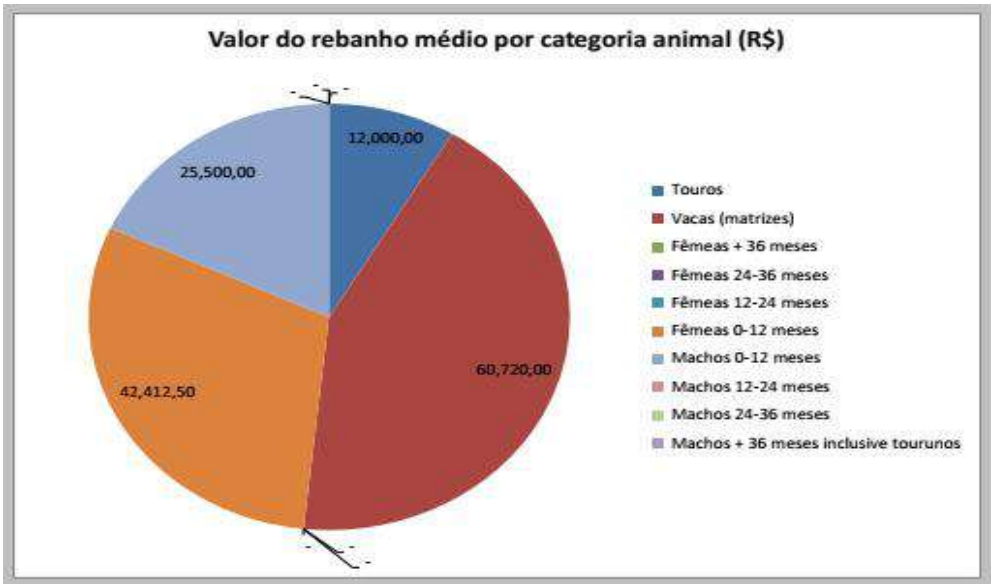
Categorias animais	Peso kg/cab.	Quant.cab.	em cab. %	Quant. UA	Composição em %	R$/cab.	R$/Categoria
Touros	450	2	6,3%	2,0	15,4%	6,000,00	
Vacas (matrizes)	240	17	52,4%	8,8	67,7%	3,680,00	
Fêmeas + 36 meses	-	-	0,0%	-	0,0%	-	
Fêmeas 24-36 meses	-	-	0,0%	-	0,0%	-	
Fêmeas 12-24 meses	-	-	0,0%	-	0,0%	-	
Fêmeas 0-12 meses	73	9	28,6%	1,5	11,1%	4,712,50	
Machos 0-12 meses	85	4	12,7%	0,8	5,8%	6,375,00	
Machos 12-24 meses	-	-	0,0%	-	0,0%	-	
Machos 24-36 meses	-	-	0,0%	-	0,0%	-	
Machos + 36 meses inclusive	-	-	0,0%	-	0,0%	-	
TOTAL		32	100,0%	13,0 100,0%			140,632,50
	cab./ha			UA/ha			
Lotação das pastagens	0,2			0,1			

Fig.11– Worksheet 5. Herd report (year averages).

Source: Prepared by the authors. 'Custobov' spreadsheet base.

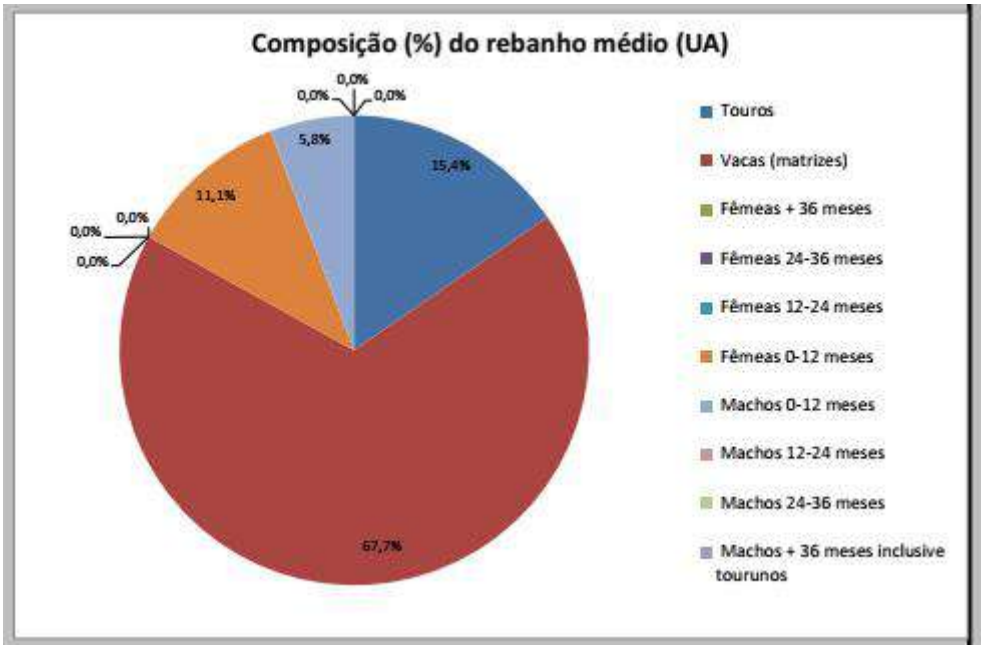
In the aforementioned worksheet, in addition to the control by weight, quantity, it is possible to analyze the percentage, which is a differential in terms of stock control.

You can also analyze the herd by graphs 2 and 3 below:



Graph 2– Average herd value by animal category (R$).

Source: Prepared through data entered by the authors. 'Custobov' spreadsheet base.



Graph 3– Composition (%) of the average herd (AU).

Source: Prepared through data entered by the author. 'Custobov' spreadsheet base.

The 'Custobov' worksheet, in terms of inventory control, is completed with charts 2 and 3, and is therefore an excellent management tool for cattle breeders in general, especially small ones, as this worksheet has free access , as it is made available by EMBRAPA.

IV. CONCLUSION

It is understood that livestock in Brazil has a relevant growth, and that new technologies and information help in decision making for activities in the field, in the beef cattle industry, one of these available information technologies being the spreadsheet. 'Custobov', from EMBRAPA.

According to Corrêa (2009, page 3):

> The great concern in this activity is the quality of production results. In this case, in order to obtain good results, management has a fundamental role. Management is responsible for the constant search for innovations in the production of beef cattle, always looking for the best ways to facilitate handling and produce quality.

For the management of beef cattle raising, constant study and use of technologies is necessary to improve the quality of production, but it requires high investments, daily monitoring in livestock management, a critical view of the performance of animals, planning on expenses (investments, expenses and cost), introduction and use of technologies, correct food controls, among others, of which stock control was addressed in this research.

The general object presented was achieved, since the Excel model 'Custobov' clearly demonstrated the control of stock in the rearing, rearing and fattening stages, being an excellent management tool for small beef cattle breeders.

We emphasize that the study in the beef cattle management rural property was intended to help smallholders to understand the importance of stock control in the beef cattle activity.

Notoriously, the valuation of stocks is important, as well as all the analyzes that can be carried out based on the spreadsheets and graphs available in the Excel model, in order to contribute to the success of the business.

As a recommendation, we suggest that this study can be carried out on a rural property using all the spreadsheets available on 'Custobov', which includes the control of expenses, depreciation, capital cost, revenues and DRE - Income Statement for the Year, in separate spreadsheets and accompanied by tracking reports and graphics.

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Safe walking: Analysis of sidewalk segments in Belém – Pará

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Keywords*— *Sidewalks, Walkability, Lighting, Pedestrian Flow, Public Safety.

***Abstract*—** *Introduction: The study analyzes "safe and secure" walking in urban spaces. Problem: To what extent do street lighting and pedestrian flow contribute to improving public safety in the urban environment? General Objective: To analyze the contribution of public lighting and pedestrian flow to improving public safety in the urban environment. Materials and Methods: Applied, descriptive and multidisciplinary study, with a quali-quantitative approach. Data Collection: Bibliographic and field research. Spatial and temporal delimitation: four sidewalk segments in Belém, Pará, August 2021. Variables: lighting and daytime and nighttime pedestrian flow, referring to the Public Safety category, analyzed according to the Institute for Transportation and Development Policies (IPTD) and theoretical referential. Results: Three of the four segments present reasonable walking conditions; they have sufficient width despite the obstacles. Concerning lighting, no points are facing the sidewalk. As for the number of pedestrians, only one segment was insufficient, the others were good. Conclusion: Pedestrians need sidewalks with adequate infrastructure, lighting, and easy access to other locations. These are conditions that ensure the maintenance of health and well-being in addition to improving public safety.*

I. INTRODUCTION

The act of walking has been part of human life since the beginning of its presence on Earth, whether it is to search for food, hunt animals, look for new areas to live in, or practice physical activities in the open air. The conception of walking has not changed; what has changed are the conditions of how to exercise it, especially in urban areas, whose uncontrolled growth, coupled with a lack of planning, has relegated to a secondary plan the life of man as a pedestrian, making it difficult for him to walk short distances, despite the relevant data presented by the National Agency of Public Transport (ANTP) that in "cities with more than 60. 000 inhabitants, 36% of trips are made on foot to their destinations, while 27% are made in individual motorized transport and 29%, in collective public transport"(ITDP Brazil, 2019, p.9).

Thus, from the pedestrian perspective, aiming at their safety, one realizes the importance of seeking alternatives that ensure the improvement and conservation of sidewalks through "investments in urban infrastructure aimed at improving the conditions of walkability in Brazilian cities" (ITDP Brasil, 2019, p.9).

The analysis of walkability presupposes the need for the urban space to be configured appropriately for

pedestrians, enabling them to interact with the various means of transportation and places in the city.

> Walkability comprises aspects such as the conditions and dimensions of sidewalks and intersections, the attractiveness and density of the neighborhood, the perception of public safety, road safety conditions, and any other characteristics of the urban environment that influence the motivation for people to walk more frequently and use urban space (ITDP Brazil, 2019, p. 10).

The tool for measuring the index of walkability (iCam) was presented in 2016 by the Institute for Transport and Development Policy (ITDP), consisting of 15 indicators distributed into six categories (Environment, Attractiveness, Sidewalk, Mobility, Public Safety, and Road Safety), being that "each one of them incorporates a dimension of the walking experience (...) and are used as central reference parameters for the evaluation, defining the distribution of the score" (ITDP Brazil, 2019, p. 13).

In this study, the Public Safety category was chosen, considering its breadth about the interaction between man and the public space, notably the street and open spaces, such as squares and parks. There is a need to seek a redesign of the urban space that, at least, tries to minimize the deep socio-spatial and environmental inequalities that exist in Brazil.

Despite the efforts of both the government and society to improve the rates, the field of public security continues to be one of the most difficult to achieve in terms of reducing the number of cases of crime, considering the multidimensionality of the theme, which involves very diverse aspects - social, economic, environmental and political. The studies on public security in Brazil and the world go through many biases that make decision-making difficult. However, the urgency of the theme is growing and requires that other perspectives, such as urban design, for example, be used to contribute to its better understanding.

Jacobs' (2011, p.29, 36) study highlights the importance of streets and sidewalks for cities to be dynamic, considering them as "the principal public places (...) if the city streets are free from violence and fear, the city is therefore reasonably free from violence and fear." She goes on to say that public order depends much more on "the intricate, almost unconscious network of spontaneous controls and behavioral patterns present among and enforced by the people themselves" than on police intervention. For the author, a safe street needs public and private spaces to be truly separated, with "eyes to the street" and having people "transiting uninterruptedly."

In other words, public safety must be understood by the person as the feeling that they are safe; it is abstract, therefore. However, this abstraction is translated concretely through an environment that allows people to come and go safely.

In this sense, the iCam (ITDP Brazil, 2019) attributes to the Public Safety category two indicators, street lighting, and daytime and nighttime pedestrian flow, highlighting, however, that due to the multifaceted character, other elements are essential, such as sidewalk conditions, attractiveness, and mobility potential, for example.

After contextualization, we formulate the central question of this study: To what extent do street lighting and pedestrian flow contribute to the relationship between walkability and the feeling of public safety in the urban environment?

We aim to analyze the contribution of public lighting and pedestrian flow in the relationship between walkability and the feeling of public safety in the urban environment.

The motivation and justification for this study lie in need to broaden the discussion about the importance of guaranteeing people, especially those who walk, cities whose pillars are vitality and sustainability.

II. SIDEWALKS AND WALKABILITY

The complexity that permeates the analysis of walkability leads to the consideration of the influences that the urban environment exerts on the pedestrian, favoring or not, walking. In this sense, it is not enough to have a narrow view of a specific sidewalk segment but a holistic understanding of how and why the pedestrian uses it.

> Urban planning neglects the “human dimension (…) a common characteristic of practically all cities is that people who use public urban space, on a large scale, have been increasingly mistreated”. These are limited public spaces, with “obstacles, excessive noise, pollution, accident risk, and degrading conditions” that “are part of the daily lives of urban residents” (GEHL & SVARRE, 2017, p. 13).

Walking on safe sidewalks goes beyond the issue of safety for the pedestrian, it should demonstrate the liveliness of healthy urban spaces, contribute to the improvement of public health by reducing sedentary

lifestyles, and also allow the full insertion of the concept of sustainability.

Gehl & Svarre (2017, p. 15) corroborate Jacobs (2011) by stating that

> A walkable city, by definition, has a cohesive structure, offering short pedestrian distances, space, and a variation of urban functions. In this way, the street becomes more observable and there is a greater incentive to follow what is happening around houses and buildings. These elements intensify activity as well as provide a greater sense of security.

Sadik-Khan & Solomonow (2017, p.21) point out that understanding people's use of sidewalks "would be an essential starting point for reactivating streets and cities in the way people themselves seek to define them. Sidewalks are not simply concrete strips at street level above the street along which pedestrians walk." They are highlighted as "a valuable space," whether in residential, commercial, or a "maze of narrow alleys."

In a study conducted by Dias (2019), Belém ranked last among the 27 Brazilian capitals, including the Federal District, regarding the conditions of its sidewalks. Thirteen items were evaluated, among which, "regularity and inclination of the floor, width, barriers and obstacles, conditions of accessibility ramps, pedestrian crosswalks, pedestrian traffic lights, maps and orientation signs, arborization and landscaping, urban furniture, air pollution, urban noise, and safety." The municipality's situation reflects the neglect of the pedestrian and the care and presentation of the space.

By enabling people to walk and, therefore, to have a greater presence in the streets, "the potential for a safe city is reinforced." However, it is noticeable that in most cities around the world, the difficulties for the implementation of road systems that prioritize the pedestrian are perceptible, although positive examples have been increasing, such as Copenhagen, Melbourne, and Venice, the latter, designed for pedestrians since its foundation (GEHL, 2013, p.6).

III. MATERIALS AND METHODS

The present study is applied, descriptive and multidisciplinary, with a quali-quantitative approach. Regarding data collection procedures, it was used bibliographic and field research (Sá, 2013).

The spatial and temporal delimitation is Belém, capital of Pará. Data collection was carried out during October 2021, in four segments of sidewalks delimited by the polygon formed by Travessa 14 de Março, Avenida Gentil Bittencourt, Avenida Alcindo Cacela, and Avenida Conselheiro Furtado, involving two neighborhoods, Nazaré and Cremação (Figure 1).

Fig.1: Spatial delimitation of the study
Source: elaborated by the authors, based on https://mapas.guiamais.com.br/belem-pa/.

The choice for the segments presented was due to the possibilities that the pedestrian has, when walking through these locations, to be able to reach touristic points of the city, such as the Emilio Goeldi Museum of Para and the Basilica Santuário de Nazaré, as well as the proximity of various commercial establishments, in addition to points of public transport.

Two variables were analyzed: lighting and daytime and nighttime pedestrian flow, according to what was suggested by ITDP Brazil (2019) for the Public Safety category.

The information on lighting and daytime and nighttime pedestrian flow was surveyed and processed as follows:
(a) Lighting: considering the impossibility of illuminance measurement, the criteria suggested by ITDP Brasil (2019, p.45) were adopted for an alternative survey:
Lighting points are facing the street (vehicle circulation lanes) - Score +20;
There are lighting points dedicated to pedestrians, exclusively illuminating the sidewalk - Score +40;
There are lighting points at the ends of the segment, illuminating the crossing (score +20 if only one end) - score +40
There are lighting obstructions caused by trees or broken lamps - Score -10.
After the survey, the "yes" or "no" answers were crossed with their respective weights to arrive at the sum, highlighting that the ideal score would be +100, "for the segment to meet all the quality criteria of the public lighting infrastructure" (ITDP BRASIL, 2019, p.45).
(b) Daytime and nighttime pedestrian flow: pedestrian counts were conducted on two working days, at each of the locations, for 15 minutes, within the intervals between 7 a.m. and 7:15 a.m.; between 1 p.m. and 1:15 p.m.; between 6 p.m. and 6:15 p.m. (ITDP BRASIL, 2019, p. 46).

After collection, it was summed, then divided by the number of counts (three). The average pedestrian flow/minute was obtained by dividing the result by 15, making it possible to reach the score of the analyzed place, according to criteria suggested by ITDP Brasil (2019, p. 46):

If ≥ 10 pedestrians/minute or ≤ 30 pedestrians/minute - Score 3 - great;

If ≥ 5 pedestrians/minute - Score 2 - good;

If ≥ 2 pedestrians/minute - Score 1 - sufficient;

If < 2 pedestrians/minute or > 30 pedestrians/minute - Score 0 - insufficient.

Although the focus was on the variables lighting and daytime and nighttime pedestrian flow, the study also included observing the infrastructure conditions of the analyzed sidewalk segments, considering the multifaceted nature of the Public Safety category.

The analysis of the information took into consideration the theoretical reference and its crossing with the results and observations of the variables.

IV. RESULTS AND DISCUSSION

For the analysis of the segments, the following direction was adopted: Travessa 14 de Março, Avenues Gentil Bittencourt, Alcindo Cacela, and Conselheiro Furtado.

(a) Field observation

Regarding the floor, although all sidewalks are paved and wide, except for the segment of Travessa 14 de Março, on the right side (Figure 2), we noticed the existence of numerous obstacles, such as holes accentuated unevenness, mainly due to residential garages. However, given the width of the other segments, people with reduced mobility can pass through these spaces using wheelchairs or other accessories.

Fig.2: Right sidewalk of Travessa 14 de Março
Source: authors, 2021.

As for afforestation, on Travessa 14 de Março, it is practically non-existent, with some shrubs located on the central sidewalk, called "footbridge" by the residents because it is the cover of a canal, does not support larger trees capable of providing shade. In the other segments, one can observe trees predominantly of the mango tree type, planted along the sidewalks, highlighting the left sidewalk of Avenida Gentil Bittencourt, which has an adequate amount of trees to provide shade. Another point to be highlighted is the left sidewalk of Avenida Alcindo Cacela, a commercial segment (gas station, gym, church, department store with supermarket and dental care store) that does not have any vegetal species planted on the sidewalk. The climatic characteristics of the region stand out, with high temperatures throughout the year, as well as an increased incidence of rainfall.

As previously mentioned, the choice for these segments was mainly due to the access possibilities to several points in the city. Thus, the pedestrian who lives in the neighborhoods of Nazaré and Cremação can walk to places like stores and supermarkets, churches, schools, leisure areas, medical offices, beauty centers, beauty salons, and squares. These segments allow these accesses, besides having public transportation points, except in the segment of Travessa 14 de Março. It can be verified that at the confluence of Alcindo Cacela and Conselheiro Furtado Avenues, there is a more effective presence of public security agents through the more frequent passage of Military Police cars.

There are boulevards and villas, such as those of Jardim Independência and Conjunto Santa Maria de Belém and the Vilas Alegre, Natal and Pará (Gentil Bittencourt and Conselheiro Furtado Avenues), constituting important access channels connecting the segments under analysis to other high flow routes, such as Magalhães Barata and Mundurucus Avenues.

In the observed segments, except for Avenida Alcindo Cacela, predominantly commercial, the others have "eyes to the street," corroborating Jacobs (2011), with facades mainly constituted by open railings and therefore are an extra attraction for pedestrians to walk with a sense of security. Because they are located in central neighborhoods of the urban area, with a considerable concentration of middle- and high-income residents, residences built-in masonry have some attractiveness for pedestrians, even serving for early morning walks.

(b) Illumination

Although the segments analyzed have public lighting, all the points are facing the street; none is dedicated to pedestrians lighting the sidewalk.

It was verified that, except for the segment of Travessa 14 de Março, which had a post with a burned-out light bulb, throughout the observation period, totaling 50 points, the other segments reached 60 points, which was below the ideal of 100 points.

Regarding the segment of Travessa 14 de Março, it is important to highlight the occurrence of robberies in the vicinity of the area without lighting, corroborating with ITDP Brazil (2019, p. 44) when showing that

> A well-lit sidewalk creates conditions for nighttime use of public spaces and favors the perception of safety by pedestrians. Moreover, it is a key element in promoting public safety: the occurrence of crimes can decrease by up to 20% with investments in lighting, compared to the 5% reduction coming from a camera surveillance system.

It is noteworthy that most homes have patios with lighting during much of the nighttime period, contributing significantly to pedestrian safety when walking.

(c) Pedestrian flow

The results found corroborate Jacobs (2011) and Gehl (2013), noting considerable "coming and going" throughout the day, mainly because these segments serve as important circulation channels, connecting various parts of the city in different neighborhoods.

In the pedestrian/minute count, the data found were: Travessa 14 de Março, 5.6 pedestrians/minute; Avenida Gentil Bittencourt, 5.1; Avenida Alcindo Cacela, 31.4 and at Avenida Conselheiro Furtado there were 17.9 pedestrians/minute. These numbers, according to the criteria suggested by ITDP Brasil (2019, p.46), are considered "good", except for Avenida Cacela, which proved to be "insufficient", a result that can derive from the fact that this segment concentrates numerous commercial activities, highlighting that people can reach it through other segments not analyzed in this study. About the data from Avenida Cacela, one can see how much this calculation tool corroborates reality, considering the number of robbery occurrences in this location and its surroundings, justifying the constant passage of the Military Police vehicle.

The results are in line with the study by ITDP Brazil (2019, p.46) when affirming the need for sidewalks to allow people to move around, to keep the street "alive", giving them a sense of security, "the presence of pedestrians at different times of the day and night works as a natural surveillance element and tends to attract other pedestrians, contributing to a virtuous circle of street use." However, he points out that "excessive crowding of pedestrians at specific times and places may cause discomfort or risks related to public safety", i.e., balance in the number of people walking is essential to maintain a healthy relationship between pedestrians and the street, to enable them to walk safely.

V. CONCLUSION

By investigating the relationship between walkability in the urban environment and public safety, through the contribution of street lighting and pedestrian flow, it can be concluded that (a) despite the physical obstacles and the public lighting not facing the sidewalk, the analyzed sidewalk segments, present reasonable walkability condition, given their widths are sufficient for the pedestrian to walk, except in the right sidewalk of Travessa 14 de Março; (b) regarding the pedestrian flow, the results were considered good, except in the segment of Avenida Alcindo Cacela, which does not invalidate the character of reasonability for the pedestrian to make use of the sidewalk. Thus, the question formulated in this study was answered, meeting the intended goal.

Finally, it is essential to emphasize that studies such as this one emphasize the importance of understanding the role that sidewalks represent for the urban environment, mainly due to the possibility of citizens becoming assiduous pedestrians, taking trips in which they have a sense of safety, an essential condition for the maintenance of this activity. Mobility, facilitated by the conditions of sidewalk infrastructure, is positive not only for the vitality of streets and reduction of polluting conditions of vehicles, for example, but mainly for the maintenance of people's health and well-being.

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Skills and difficulties in the role of nurses in aeromedical transport

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***Keywords*— Nursing. Aeromedical transport. Intensive therapy.**

***Abstract*—** *Objective: to describe the skills and difficulties in the role of nurses in aeromedical transport. Method: descriptive, exploratory study with a qualitative approach. Data were collected through in-depth interviews, from October to November 2019, with a sample of seven nurses who work in an aerospace transport service, located in the metropolitan region of Belém, State of Pará, Brazil. Data analysis was based on the thematic content analysis method proposed by Bardin. Result: four empirical categories emerged: "Attributions, competences and difficulties in the role of nurses in aeromedical transport; Considering the epidemiological reality and regional differences; The nurse as a member of the multidisciplinary team; prerequisites for performance". Conclusion: health professionals who work in air transport have different interpretations about the work they perform. In addition, the on-board nurse assumes a prominent position, their work is full of demands and challenges that require knowledge, skills, competences and attitudes to*

carry out the on-board service, aiming to maintain an efficient and effective practice, even in the face of adversities of this type of service.

I. INTRODUCTION

Nursing is one of the professions in the health area that conceives the human being in its fullness and, therefore, has the opportunity to experience new areas, not limited to conventional care situations[1]. In this context, the insertion of nurses in aerospace services emerges as possibilities for action, being supported by the resolution of the Federal Council of Nursing (COFEN) n. 551/2017, which regulates the role of nurses in pre-hospital mobile and inter-hospital care in an air vehicle[2].

Aeromedical Transport (TAM) is described as the displacement of the patient and/or injured person in a critical condition, by air locomotion seeking transport under adequate and specialized, safe and immediate professional supervision, in the condition in which another type of transport is not available. available and/or climatic or environmental conditions do not allow its use, crossing geographic barriers for the removal of the patient in a short period of time[3].

The Air Rescue (Aeromedical) consists in the search, location and rescue of people in situations of injury victims, or at risk of suffering injuries, in places of difficult access. The procedures and type of care performed by the aeromedical service demonstrated the relevance of this type of care for trauma patients, among other conditions, who required a reduced response time, specific care for the environment, fast transport and definitive treatment in a shorter period[4].

The service using helicopters for the rescue and rescue of people, aims to provide pre-hospital care at the scene of the accident, adult and neonatal inter-hospital transport, removal of patients in difficult to reach places, aerial reconnaissance of the place of accidents, rescue, in addition to the support given to ground teams in mobile pre-hospital care[5].

Aeromedical transport can be defined in two ways: rotating wing (helicopters), which is used for places with difficult access, due to having the possibility of landing in different types of locations, and fixed wing (planes) to travel great distances in a shorter period of time, given the clinical conditions of the patient and needing a runway for a qualitative landing6. A study conducted in the State of Santa Catarina shows the importance of using rotary-wing aircraft, revealing that in the two-year period (2014 to 2016) there were 1,071 calls carried out by the Air Operations Battalion (BOA) with the archangel helicopter in the metropolitan region from Florianópolis – Santa Catarina, Brazil[7].

Use of aircraft to rescue people began in 1870 in the Franco-Prussian war when military soldiers were removed from the battlefield with the aid of hot air balloons, during which 160 wounded people were rescued. The wars brought advances in medical science and health and in the production of technical-scientific knowledge, especially after the First World War. In Brazil, the Aeromedical Service is part of the Emergency Care Network (RAU) of the Ministry of Health (MS), with the use of aircraft such as helicopters and planes, to care for patients in urgent and emergency situations[3].

The ambulance is a means of transport in which it is possible to carry out transportation by land, water and air, and is exclusively intended for the transport of patients. This type of service is performed by several types of vehicles, namely: type A ambulance (transport ambulance), type B (basic support), type C (rescue ambulance), type D (advanced support), type E (air ambulances) and F (waterway ambulances)[8]. Ordinance MS, Ministry Office (GM) n. 2048 of November 5, 2002, cap. 04, item 1.3; lists the Specific training of Aeromedical Transport Professionals. In item 2.1, it defines that aeromedical aircraft are classified as type E, both helicopter (rotating wing) and airplane (fixed wing), duly equipped with equipment approved by the National Civil Aviation Agency[9].

The use of a type E ambulance (air ambulance) is necessary due to the agility required in the care of critically ill patients, in conditions which it would be unfeasible to carry out by land transport, due to traffic and conditions that make it more difficult to access, such as geographic and climatic barriers, among other challenges. The aircraft has limited space and the patient is positioned on the stretcher or board in the transverse direction, which increases the challenges for the multidisciplinary team that works in this sector, including the nurse[10].

Resolution COFEN[11] n. 660/2020, provides guidelines regarding the training of aeromedical or aerospace nurses, as this training corresponds to a nursing specialty. The Brazilian Civil Aviation Regulation (RBAC-90) describes State aviation (Public Air Unit-UAP) in special air operations. In its subpart C – requirements for airmen, sub-items: 90.43 (exercise of the medical support operator function) and 90.45 (onboard health professional); describe the distinctions in the activities of the aerospace

healthcare professional and requirements for serving in the UAP.

The speed at which the patient needs to be directed to appropriate and definitive treatment is essential for survival. In this context, numerous factors interfere in the time of pre-hospital care, such as: traffic, time of day, place where the patient will be referred, among others. The Aeromedical Service emerges as a modality of fundamental importance, given the need to establish an effective treatment in the shortest possible time, with a view to assessment, rapid admission, early diagnosis and definitive treatment[12].

Given the above, the study aimed to investigate the skills and difficulties in the role of nurses in aeromedical transport.

II. METHOD

Descriptive, exploratory study with a qualitative approach. Companies related to the aeromedical transport service in Belém, State of Pará, Brazil, from October to November 2019 were chosen as the research field. All nurses working in the service were invited to participate in the research. Those who agreed to participate in the study were asked to sign the Informed Consent Form.

Of a total of 10 nurses, seven were interviewed until saturation around the thematic axes. As inclusion criteria, working time of at least one year, professionals of both genders and academic training in Nursing were considered.

For data collection, a semi-structured interview was used as a technique, with an interview script prepared with open questions prepared by the researchers as an instrument for collection, allowing the interviewees to discuss the questions without pre-determined time for answers.

Nursing course students, previously trained to apply the research instrument, participated in the data collection. Data collection was carried out on the premises of the units through a semi-structured interview recorded in audio.

The contents of the interviews were transcribed in an original way, preserving the expressions used by the participants. However, in order to use them as a unit of analysis, spelling corrections were made, language vices, exchange or absence of letters were excluded, while maintaining the linguistic vices that present meaning in the context of speech.

The data were treated and the results constructed according to the methodological framework of thematic content analysis proposed by (Bardin 2016), which enabled the identification and construction of four thematic categories: “Assignments, competences and difficulties in the performance of nurses in aeromedical transport; Considering the epidemiological reality and regional differences; The nurse as a member of the multidisciplinary team; prerequisites for performance.” The categories were previously delimited due to the thematic axes of the interview script, being confirmed after in-depth analysis of the speeches.

Free and Informed Consent Term was individually explained to the research participants, who were coded and identified with the following names: “E 1”, “E 2”, “E 3...” respectively, in which, “E” represents “Nurse” and the number the order in which they were approached, aiming to preserve the anonymity and confidentiality of the information.

Resolutions n. 466/12 and n. 510/16 of the National Health Council (CNS) and only after the appreciation and approval of the Research Ethics Committee (CEP), with the Certificate of Presentation and Ethical Appreciation (CAAE: 18760819.7000.5173) and opinion number n. 3,528,052 the research was started, respecting the norms of the National Research Ethics Commission (CONEP) and the National Health Council (CNS).

III. RESULTS

It was found that among the seven participants, four were male and three female. The age ranged from 27 to 55 years, and the individuals were mostly married (71.4%). 100% of the participants have a Lato Sensu postgraduate degree, with seniority ranging from 1 to 10 years of experience.

Participants were characterized according to marital status, gender, age, postgraduate studies, frequent updating in the area. Of the 10 possible nurses to be interviewed, 7 participated in this study, 01 were unable to participate due to lack of time to conduct the interview, and the others were excluded after applying the inclusion and exclusion criteria.

Table 1 - Characteristics of study participants, according to marital status, gender, age, postgraduate studies, Belém, Pará, 2019.

Code	Age	Gender	Marital status	Postgraduate	Strictu Sensu Post Graduation	Update on aeromedic	Update time
E1	44	M	Married	Yes	No	Yes	3Months
E2	47	M	Married	Yes	No	Yes	6Months
E3	27	M	Married	Yes	No	Yes	9Months
E4	55	F	Single	Yes	Yes	Yes	3Months
E5	46	F	Married	Yes	No	Yes	3Months
E6	43	F	Single	Yes	No	Yes	3Months
E7	45	M	Married	Yes	No	Yes	4Months

Source: Field research, prepared by the authors, 2019.

The corpus of the study made it possible to organize the content into four empirical categories, grouped according to the theme extracted from the responses: Category 1: "Attributions, competences and difficulties in the role of nurses in aeromedical transport; Category 2: Considering the epidemiological reality and regional differences; Category 3: The nurse as a member of the multidisciplinary team and Category 4: prerequisites for work", which will be presented below.

Category 1: Attributions, competences and difficulties in the role of nurses in air medical transport

This first category describes the nurses' knowledge regarding the attributions, competences and difficulties experienced in daily life in exercising their profession as a nurse in aeromedical transport, as can be seen in the statements:

> *"[...]Nurse who is on board must be a skilled nursing practitioner, so that there is no interruption in the treatment in terms of medication and monitoring". (E2)*

> *"[...] The first would be our management of the aeromedical service as a whole! The nurse's role is mainly in the pre-flight, which predicts what you can use, the trans is during transport, works in transport evaluating, monitoring, administering medication, among other actions, and post-flight, when you already deliver the patient for the ground ambulance for example". (E1), (E4), (E7)*

> *"[...] We cannot even, by law, put anyone to fly, we have to obey the COFEN legislation that supports us". (E2) "[...] Nurses have to be qualified for such transport, trained, he is the transport manager, as well as assistant and caregiver in the same period of time". (E3)*

> *"[...] I consider it a challenge not to have a dedicated aircraft, an aircraft exclusively for aeromedical transport, because the aircraft we use here is from the State security air group, so sometimes we do not provide assistance because of not having an available aircraft". (E5)*

> *"[...] I see limited space as a challenge! This is part of the difficulty, and also, I don't believe it is a difficulty, but the devaluation, because it is a very important service and it is not recognized". (E6)*

Category 2: Considering the epidemiological reality and regional differences

In relation to category two, we sought to identify the nurses' knowledge about the difficulty in performing the nursing service in aeromedical transport in view of the peculiarity of our region and what are the skills and difficulties in working in this environment. It was observed that nurses have similar thoughts about this difficulty.

> *"[...] In our region, we have to remember that we have a continental State, the size of a continent, larger than many countries in Europe, and in its geography most are*

fluvial, we have Marajó as our location. performance, where we serve more often." (E4), (E7)

"[...] Marajó, especially because it is very lacking in a place of service, a municipality with great difficulty in transporting, getting here, so I think that aeromedical services are extremely important, because access is all by water, there are locations which is 12 to 24 hours by ship to get here". (E6)

"[...] So, Portel, for example, it should take a 12-hour ship trip to get here, so we see the regions with restricted access to health as a difficulty, so the aeromedic comes to help a lot in this transport which I believe will increase the survival of these patients". (E6)

"[...] 1 hour to bring from Breves, Portel, these faraway places, aeromedical transport is necessary for this region, we have 144 municipalities, so of these 144, 74 are in the coverage, aeromedical rescue coverage worksheet " (E4)

"[...] As it is a very characteristic region of the Amazon, there are certain runways that are not approved, and this ends up being restricted, during the take-off and landing period in certain locations". (E3)

"[...] Aircraft, they can't fly more than 2 hours, they don't have the flight autonomy to fly all that and in many places you only get there in 24 hours". (E5) "[...] Climatic variations are also a factor that makes it difficult, the other is the geographic issue of our state, the geographic distance from our state is very large". (E1)

"[...] The aeromedical service in the Amazon turns out to be the patient's last resort in some circumstances (pause). We end up being the savior of the homeland, so the people from the aeromedical team act responsibly, carrying out clinical evaluation, evaluating the case, flight time". (E2)

Category 3: The nurse as a member of the multidisciplinary team

In this category, the importance of the nurse as a member of the multidisciplinary team was verified, understanding that the results of their attitude towards other professionals and the patient's clinical condition may result in better patient care and better outcomes, as can if you observe in their speeches:

"[...] He has vast knowledge within his area and this should be put in the best, rational and systematic way possible, for the patient to have better care, given that they are critical patients, and the outcome depends on this absdagem ". (E1)

"[...] Without a nurse, there is no aeromedical person, because that way, the nurse has a managerial function, an administrative function, forecasting and provision of materials and equipment, among other actions". (E2)

"[...] A great conductor will often manage the whole issue of patient monitoring, vital signs, will check water control, how much is being eliminated, in addition to effective communication with the medical professional throughout the process carriage". (E3)

"[...] The nurse would not be able to carry out the rescue alone, so it is a team that completes itself". (E4)

"[...] The doctor has his behavior, the nurse his own, but they are always discussing the case. I think both are fundamental pieces, both the doctor and the nurse, not only in aeromedical medicine, but in health, regardless of where the care takes place, one cannot live without the other". (E6), (E7)

"The safe transport of the patient, then we get into those international safety goals. The patient's survival, and what you do right or wrong will impact survival." (E3) (E4)

Category 4: prerequisites for acting

In this category, nurses were asked what the importance of professional qualification would be and what requirements they would need to be able to work in aeromedical transport, in order to provide a quality service. In this understanding, the following speeches emerged:

"Ideally, he should be an intensivist, an urgent care worker! Who has a degree from the Institute of Education and Health of São Paulo. Even because aerial physiology is

not the physiology we learn at the gym[...]" (E2), (E3)

"[...] A postgraduate course in urgency and emergency, some specific pre-hospital courses, because it is a pre-hospital service, an operational crew course". (E6) "He has to be aware of the rescue, he has to be aware of the actions and impacts of altitude on the patient and on the nurse [...]" (E3), (E4)

"Well, first thing you have to like the emergency service, if you don't like it you don't take chances, the second thing, you don't have to be afraid of flying, if you're afraid of flying you can't work in this service either, and the third thing is for you to really know what you are doing, study, seek research, dedicate yourself and improve every day. But without liking the urgency and not liking to fly, you can't work in aeromedical! [...]" (E5)

IV. DISCUSSION

Regarding the characterization of nurses, in Brazil, several studies have shown that this profession is mostly marked by the presence of women. However, in the aerospace environment this profile has been different, with a marked presence of male individuals[13].

This result is in line with other research that consider the presence of men in some nursing services, such as the Intensive Care Unit, Psychiatric Emergency and Emergency Services and Mobile Emergency Service, making considerations that seem to link this presence to physical fitness, preparation and management of emotions[14,15].

As for age, the interviewees are nurses in their professional maturity stage, which is characterized by their full capacity to develop their cognitive, practical and technical functions[16].

Observing the professional experience, with regard to the length of experience in the service, it was evident that the interviewees are professionals with significant experience in aeromedical transport, in which the average number of years of experience is six years. From these results, it is possible to infer that most participants had considerable professional experience, results similar to those described in a study on the profile of nurses in the Mobile Emergency Care Service of Santa Catarina, Brazil[17].

Regarding the type of institution and aircraft in which the nurses are manned, the performance in public services (69%) and in rotary-wing aircraft (64%) stood out in the metropolitan region of Belém. This result is in line with the study by Pin (2018)[16], in which the performance in public service (68%) and in rotary-wing aircraft (54%) was also observed. Here, it is worth noting that the greater amount of public services in Brazil can be explained by the link of professionals and agreements with public security sectors, the Military Police, such as the partnership established by the health department and the State Public Security Air Group of Pará-GRAESP.

It is described that the use of aircraft is shared between health and public safety services, being used not only for emergency care, but also in police operations, multi-mission, inspection and troop transport. This sometimes makes the logistics of work hampered by having to assemble the equipment and dismantle it at the end of its use due to the fact that the State of Pará does not have an aircraft exclusively dedicated to aeromedical transport[16].

In Pará, where we have the Marajó archipelago, places of difficult access, geographic barriers, lack of minimum infrastructure for fixed-wing aircraft take-offs and landings, aeromedical transport by rotary-wing aircraft becomes effective due to its particularities and adaptable conditions in the environment be favorable for these purposes, as they facilitate movement and access to difficult-to-service places, where they can land vertically without the need for an approved runway or according to the standards suggested by the National Civil Aviation Agency-ANAC for landing[16].

With regard to academic training, no nurse is a specialist in Aerospace Nursing, but all respondents had a lato sensu postgraduate degree in Intensive Care, and 40% of them were also specialists in Urgency and Emergency.

Given these results, it is important to consider that specialization courses in Aerospace Nursing are still scarce in Brazil, especially in the northern region of the country, considering that this is a relatively new specialty. In addition, many aerotactic nurses reported having previous experiences in other intensive care environments, which justifies taking specialization courses in these areas[7].

With the conclusion of the study, participants' search for additional and essential courses to be able to work in the service stands out, such as: Advanced Life Support, the Pre-hospital Trauma Life Support® (PHTLS) which qualifies professionals for trauma care , and the Advanced Cardiac Life Support® (ACLS), which aims to develop

life support skills for emergency cardiovascular care (ACE) for example[19].

Regarding the duties of the nurse in aeromedical transport, it can be observed that the professional works in the three phases of transport, but during the interview the one that stood out the most were the managerial functions of their training, in the pre-flight with the checking of materials, in-flight with organization of documents and hemodynamic monitoring of the patient and even post-flight with organization of the aircraft after use[20].

Another factor analyzed, highlighted by the interviewees, is that the nurse can be seen as the conductor of the aeromedical service, as he is the professional who will manage all the monitoring of the patient, whether in terms of hemodynamics, vital signs, fluid and electrolyte balance, exams, documents, team management, in addition to being an excellent articulator of patient care processes, exerting a direct influence on the outcome of the care provided[3].

In relation to the competences of the air tactical nurse, two axes were highlighted, the managerial and the assistance one. There is a consensus among the interviewees that the organization and direction of direct care to critically ill patients is the exclusive competence of nurses and where activities of greater technical complexity will be performed, such as monitoring, checking vital signs, listing the needs of that patient according to with its priority in details, so that it is possible to provide more adequate nursing care, with a view to transporting the positive outcome[21].

In the meantime, it is up to the nurse to know how to act in the field of aeromedical transport, receiving the patient from their arrival on the aircraft, until delivery at the hospital that will receive them, as well as evaluating and systematizing the processes that involve the priorities for each client, performing assistance valuing safety and integrity, offering information on all procedures that will be performed before, during or after transport, without losing sight of the need to assess all clinical parameters throughout transport[14].

It is noteworthy that in the care of critically ill patients in a conventional ICU, professionals face problems in patient management and care, whereas in the air ICU, in addition to conventional difficulties, different challenges and difficulties emerge with a greater degree of complexity, either due to the unavailability of resources , materials or even limited space to work, because of this, the communication and integration of the air team must be aligned and harmonic, so that there are no overlapping, disharmonious actions that can directly impact the patient's prognosis[14].

It is described that the restricted space and the lack of manpower to work in the airspace are the greatest difficulties for nurses, whether in aeromedical transport or rescue, due to the limited space and a restricted collection of equipment and supplies, complications become greater degrees of difficulty. Furthermore, space inside the aircraft is a stressful factor due to the reduced mobility of professionals, which has been described as a factor that generates discomfort in the team[3].

It should be noted that during the flight, which it is possible to verify in the reports, a lower frequency of medication administration, except for continuous use drugs such as vasoactives, analgesics, chronotropics, cardiotonics and replacements. Which may indicate that, for the most part, the patient is already stabilized on the ground, aiming to carry out the least number of procedures during the flight. On the other hand, the procedure that seems to be most frequently performed is peripheral venipuncture, for volume replacement or administration of medications. However, this procedure is mostly performed in the pre-flight phase[4].

As described, the nurse has responsibilities in the three stages that involve a quality flight. In the post-flight, actions focus on replacing materials and checking the equipment used, according to institutional protocol. As well as in the disinfection of used materials, referrals for processing and sterilization, and replacement of what was used. The nurse in the post-flight is also responsible for passing on information via established protocols to the next on-call physician, with the patient's data being recorded in the medical record and requesting the signature of the physician responsible for the patient at the destination hospital[14].

In Japan, from 2004 to 2011, the Japan Trauma Data Bank (JTDB) verified that 2,090 patients were airlifted to 114 reference hospitals in emergencies in the country. Rotary-wing aircraft were among the most effective modality, as they had a 73.9% survival rate when compared to patients who used conventional ground transport. Furthermore, in the United States, in a study with the same profile, it was shown that the mortality rate associated with the speed of transport was 39%, which study converges with the findings of the present research, when we verified in the interviewees' speeches, statements that confirm the importance of this type of service, impacting the survival of patients.

In our region, Ilha do Marajó, where the transport of critically ill patients is the most suitable and accessible aeromedical transport, this aspect gains greater relevance, as it is more effective mainly due to the precariousness, geographic barriers and lack of infrastructure, present in

various regions of the country, but more evident in the north and northeast[4].

Leadership was another highlighted point in the speeches of those surveyed. On this subject, leadership is considered an essential skill for nurses described in several studies, and in aeromedical transport this would be no different. Within the scope of the nurse's work, in the context of care in a multidisciplinary team, the nurse works together with the doctor who maintains direct contact with the aircraft pilots, aiming at quality care, communication that involves from the decision to use medications to be performed, even the way the pilot will land, requiring the nurse to have a clear and precise vision of their attributions and competences during aeromedical transport[22].

During the research, the speeches tend towards a consensus, the nurse is a leader in aeromedical transport. Effective communication between the multidisciplinary team must be pursued by the entire team. It is important to maintain the cordiality and respect for the autonomy of professionals so that there is no negative interference in the other member's conduct, causing disharmony and mismatch in care actions and interprofessional relationships, with a view to completing the proposal with success and quality.

V. CONCLUSION

In view of the proposed objective, it was possible to identify the understanding that air tactical nurses have about their role in the multidisciplinary team of aeromedical transport. From the results, we understand that the most relevant points on the subject were addressed, as well as the research objectives were achieved.

It was evident that the nurse works in the three moments of aeromedical transport, with an emphasis on managerial functions, in the pre-flight phase, and assistance in the intra- and post-flight phase.

The aerotactic nurse assumes a prominent position, due to the influence that the care they exercise has on the multidisciplinary team and, consequently, on patients. Nurses in aeromedical transport work with a multidisciplinary team, in which the work is full of challenges, requiring knowledge, skills and attitudes to carry out qualitative aerospace care. The main one is being able to work in a limited space with reduced movement.

There was a need for a high degree of training for professionals working in the aerospace environment, which demands a process built since graduation, marked by subsequent improvement, with skills, specializations, focused on intensive care, urgency and specific knowledge of dynamics of air transport.

Considering the benefits of aeromedical transport in assisting victims in critical condition, in places with difficult access, it is worth emphasizing the importance of this means of transport for all other services in this area.

One of the problems encountered is the operation and maintenance cost of this service. However, it is noticeable that this type of transport proves to be more effective than other modalities, reducing the mortality rate of patients. In the State of Pará, a demographically very extensive region of Brazil, in which a large part of the region is surrounded by water, arriving or leaving certain territories is only possible by means of a waterway vessel, which would cause a great delay in the service. Knowing the skills and difficulties of the nurse's role in aeromedical transport will contribute to better preparation of the team to serve this clientele.

The findings of this research allow us to affirm that the Aeromedical Transport nurse stands out as an element that works with a holistic view in meeting the individual's health needs. Its practice must go beyond the mechanical bases, adding expression and subjectivity in providing care.

In this field of action, interdisciplinarity is a fundamental component. The nurse, as a member of the multidisciplinary health team that transports patients by aircraft, is faced with demands and challenges that require these professionals to have skills that support them in adverse situations and independence in decision-making, in addition to a high degree of knowledge, attitudes and specific skills to perform this role.

Aeromedical transport is one of the most significant acquisitions in aviation and emergency care, especially in remote areas of Brazil, where geographic barriers tend to increase the degree of difficulty. Of military origin, for soldiers wounded in combat, it had marked periods in the wars, with a notable technological impulse. What has been learned in the war camps and transposed into medicine and civilian health allows for the safe and increasingly effective use of this resource. Given this, it is expected that the knowledge produced with this research, instigate aerotactic nurses to reflect on their practice and serve as support for other studies that cover this theme from other perspectives.

It should be noted that, like all scientific studies, this research has some limitations that can be minimized in future work. One of them is the reduced number of participants, from a specific region of Brazil, making it difficult to generalize the results obtained. Another limitation, despite all the precautions, concerns the

possible information biases on the part of the interviewees, such as lack of attention or understanding, rush to respond, self-censorship and fear of being identified through the statements, considering the fact of being few participants in this scenario in the State. However, these limitations in no way devalued the results obtained and the conclusions we reached.

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Retrospective study of foot-and-mouth disease in border regions of the State of Mato Grosso do Sul

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***Keywords*— foot-and-mouth, IAGRO, vesicular disease.**

***Abstract*—** *The State of Mato Grosso do Sul has a border area of 1,365 km, which causes the Agency for Animal and Plant Sanitary Defense (IAGRO), through uninterrupted activities, to carry out health surveillance actions. In these border regions until September 30, 2021, 37,889 Animal Transit Guides - GTAs were issued and 1,019,120 cattle and buffaloes were moved. The control of health surveillance in these regions is very important, so the objective of this work is to conduct a study on the foci of foot-and-mouth disease and characterize the border region of the State of Mato Grosso do Sul. It is noteworthy that the state has been without cases of foot-and-mouth disease for more than 15 years, and in this study, the outbreaks that occurred in the municipalities of Porto Murtinho (1998), Naviraí (1999) and the last, in 2005 and 2006, in Eldorado, Mundo Novo and Japorã were described. These focuses had immediate control actions, where IAGRO, with the support of the federal, state and municipal government, dedicated itself to the health emergency being addressed as soon as possible, according to data presented; and that measures such as health surveillance, health education and traffic control in fixed and mobile posts often occur in these regions. Today, six years ago, the state has a vaccination coverage above 99.20%. IAGRO is implementing its health control and surveillance actions in these regions, empowering its technical staff, acquiring and putting into operation new technologies, aiming to have a work of excellence with the main*

objective of having recognition with the status of foot-and-mouth disease-free area without vaccination, which is the greatest csuit of the entire productive class of the state.

I. INTRODUCTION

Foot-and-mouth disease is an acute infectious disease with high potential for transmissibility among susceptible animals, and can cause the disease in all animals of a herd in a short time [1]. Bortot and Zappa (2013) point out that, regardless of national borders, because it is rapidly dissected, the disease has very serious socioeconomic consequences, mainly affecting the trade in animals and animal products in international relations [2].

The last outbreaks of the disease in Brazil in 2006 (Mato Grosso do Sul and Paraná), and also the outbreaks of Rio Grande do Sul (in the years 2000 and 2001) occurred in the border regions [3]. Brazil (2017), reports that the extensive Brazilian borders with specific attributes and vulnerabilities, denote a great challenge to agricultural health surveillance and defense, especially in the entry of pathogens into the territory [4].

a) Geographical characterization of the border region of Mato Grosso do Sul, Bolivia and Paraguay.

Bolivia and Paraguay border the State of Mato Grosso do Sul (MS) internationally. According to Pereira (2009), the Brazilian border line with these two countries has an extension of 1,365.4 km, being 436.9 km of dry border and 928.5 km of border by rivers. In total, the state has forty-four (44) municipalities along the border strip [5].

Of the 44 municipalities in the border strip, Franco et al (2019) point out that only 12 (twelve) municipalities are located on the border line, being 11 (eleven) bordering Paraguay and only 1 (one) with Bolivia, also identifying that most municipalities of the MH have an urban area near the headquarters of the municipality of the neighboring country and this characteristic provides ease in traffic of people, animals and goods, as well as the exchange of services provided.

The Brazilian Institute of Geography and Statistics (IBGE), based on the Federal Constitution, identifies and characterizes the municipalities (fig. 1) of the border strip as follows:

> *"The Border Strip means "the range of up to one hundred and fifty kilometers wide, along the land borders", according to the Federal Constitution, Article 20 – paragraph 2. Based on this definition, which welcomes the parameters of Law No. 6,634, of 05/02/1979, IBGE, for geoscientific and statistical purposes, identifies and represents Brazilian municipalities with an area wretoldly or partially located in the Border Strip, which is the internal strip of 150 km wide, parallel to the land dividing line of the national territory, adding the existing information (geographic code and name of the municipality) with those produced in the identification and/or classification of the municipality of the municipality within the range, such as: borderline, partially or totally in the strip, references of the head of the border line and the boundary of the inner strip." (IBGE, 2020).*

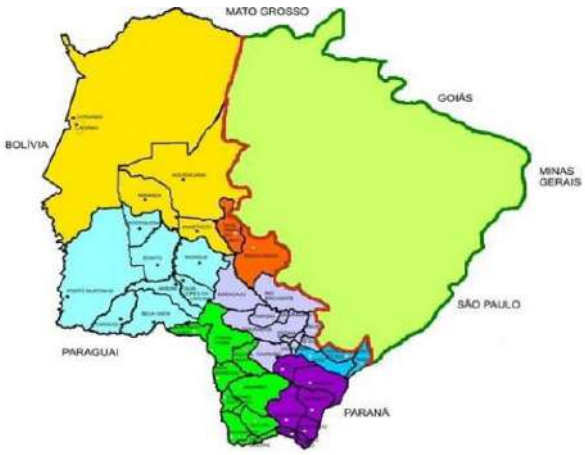

Fig. 1: Municipalities of the state of Mato Grosso do Sul (border strip)

Source: Ministry of Defense

According to information from the Portal of the Government of Mato Grosso do Sul (2018) with 3,442 km long, the Paraguay-Paraná waterway, is one of the continental integration corridors of Latin America that stands out most due to its importance, crossing 890 km from the Brazilian territory, connects Cáceres (MT) to Nueva Palmira (Uruguay) and is linked to the Tietê-Paraná waterway[6].

Also according to the Portal of the Government of Mato Grosso do Sul (2018), the Tietê-Paraná waterway has 2,400km of which, 600 km are in the MS. Dentro do Estado, this important waterway has the ports of Bataguassu (border with the State of São Paulo), with that of Mundo Novo (border with Paraná), and also with the overflow terminals in Aparecida do Taboado (also border with the State of São Paulo). This portal also mentions that, in the stretch that cuts the State of the MS, the Paraguay-Paraná waterway, the ports of Corumbá-Ladário (on the border with Bolivia) and

Porto Murtinho (on the border with Paraguay) are in operation[6].

b) Brief history of foot-and-mouth disease in South America

The first documented records of foot-and-mouth disease on the American continent begin in 1870. This year, outbreaks were recorded, almost simultaneously in the United States, Argentina and Uruguay, associated with the first imports of cattle from Europe, where the disease occurred endemically [7]. In the case of Brazil, probably, the outbreaks recorded in the same year have reached the Southern Region of the country, a hypothesis also considered by Olascoaga (2003) and Rosenberg and Goic (1973); however, the first official recognition of the disease was dated 1895[8][9][10].

Foot-and-mouth disease spread to the other regions of the country, considering the epidemiological characteristics of the disease and the process of occupation and expansion of the national territory, named by Figueiredo (1994) as "colonization by the ox's paw", since cattle ranching has always been a key tool for colonization of the "Novo Continente" [11].

In 1951, through the continuous efforts between the Government of Brazil and the Organization of American States (OAS) and due to the outbreaks of foot-and-mouth disease at the time, the Pan American Foot-and-Mouth Disease Center (PANAFTOSA) was formed under the responsibility of the Pan American Health Organization (PAHO) and in 1972, by the action of both PAHO-Panaftosa, the South American Commission for the Fight against Foot-And-Mouth Disease (COSALFA) was created [12].

In 1988, paho and the first Action Plan of the Hemispheric Program for the Eradication of Foot-and-Mouth Disease (PHEFA) was established by PAHO, the Hemispheric Committee for the Eradication of Foot-and-Mouth Disease (COHEFA), constituted through the effort of the official veterinary services (SVO) and the collaboration of the private sector. Its main objective is to eradicate foot-and-mouth disease until 2009, with the design of strategies and the political support of countries that were considered extremely necessary [12].

The eradication of foot-and-mouth disease in South American countries until 2009 has not been obtained, so a new programme was developed for the 2011-2020 management. Then, in 2012, the World Organization for Animal Health (OIE) approved a plan to control the disease globally, with the OIE and the Food and Agriculture Organization (FAO) as managers. Thus, the PHEFA was named as the program of the American continent for the control and eradication of the disease [12]. Since then, for these territories, the plan is to carry out a passage of free status without vaccination, eradicating the disease and enhancing prevention, diagnosis and early response [13].

According to Brazil (2019), Rio Grande do Sul and Santa Catarina became the first foot-and-mouth disease-free zone with vaccination in Brazil, a fact that occurred in 1998, gradually starting a process of implantation of free zones in the rest of The Brazilian territory[14]. In 2007, Santa Catarina was recognized as the first foot-and-mouth disease-free zone without vaccination, and there was also an expansion of the foot-and-mouth disease-free zone with vaccination in 2014 and later encompassing the entire Brazilian territory [14].

Specifically in Mato Grosso do Sul, 21 outbreaks of foot-and-mouth disease were recorded in 1994, two in 1998 and two in 1999, in the municipalities of Porto Murtinho and Naviraí [15]. According to Amaral et al. (2016), this State was classified by the OIE as an foot-and-mouth disease-free zone in 2001. However, in September 2005, there was a reintroduction of foot-and-mouth disease virus, involving municipalities located on the border with Paraguay. This reintroduction led to the suspension of the classification of foot-and-mouth disease free in Mato Grosso do Sul and also in other states of Brazil [15].

c) The work of health defense carried out by Brazil

The actions against foot-and-mouth disease in Brazil are shown to be a beautiful history of our animal health defense system. Especially since 2006, after the last occurrences of the disease in Brazil, the National Surveillance Program for Foot-and-Mouth Disease (PNEFA) entered the phase of consolidation of the eradication process, with evolution and maintenance of foot-and-mouth disease-free areas. Preventing the reintroduction of the virus, demonstrating its absence in the national territory, preparing for early detection in the face of possible viral agent tickets and its rapid elimination are important challenges currently imposed on the Brazilian animal health defense system [16].

According to Brazil (2021), the Strategic Plan 2017-2026 was created with the objective of maintaining and creating sustainable conditions to ensure the status of country free of foot-and-mouth disease and expand the zones free of foot-and-mouth disease without vaccination, protect livestock assets and generate benefits to Brazilian society, organized to be executed in a period of 10 years, beginning in 2017 and ending in 2026[12].

According to Brazil (2019), the Strategic Plan was provided in 16 operations, assembled into four components: strengthening the animal health surveillance system, expanding the capacities of SVs, transitioning from free with vaccination to vaccination-free zone throughout the

country and interaction with stakeholders in the foot-and-mouth disease prevention program[14].

The first version of the Strategic Plan was based on animal movement and spatial distribution analyses of herds susceptible to foot-and-mouth disease during the period 2014 and 2015. After two years of implementation of the plan, the current scenario and regional peculiarities have been adjusted (Ibid).

Also according to Brazil (2019), the federative units were separated into blocks, according to the following sequence, block I, Amazon region, being Acre, Rondônia, part of amazonas and part of Mato Grosso; block II, the Amazon region, with the Amazon, Amapá, Pará and Roraima; block III, Northeast region with Alagoas, Ceará, Maranhão, Paraíba, Pernambuco, Piauí and Rio Grande do Norte; block IV, the central region, with Bahia, Distrito Federal, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Rio de Janeiro, São Paulo, Sergipe and Tocantins; block V, the southern region, with Paraná, Rio Grande do Sul and Santa Catarina[14].

According to Brazil (2017), the Program for Quality Assessment and Improvement of Official Veterinary Services (Quali-SV) will be composed of evaluations through audits with the objective of verifying the available structures and procedures conducted by the SVs and evaluation by quality indicators[14].

In The Brazilian territory since 2005, according to Brazil (2021), the State Veterinary Services (SVEs), under the coordination of the Department of Animal Health of the Ministry of Agriculture, Livestock and Supply (DSA/MAPA) and the support of PANAFTOSA, carry out seroepidemiological studies, aiming to estimate the percentage of immune coverage of the bovine population achieved by vaccination campaigns against foot-and-mouth disease. This study is carried out in the bovine population of the area qualified for the export of fresh meat to the EU (European Union), an area composed of the States of Espírito Santo, Minas Gerais, Mato Grosso, Mato Grosso do Sul, São Paulo and Goiás[12].

In December 2006, the areas called the High Surveillance Zone (ZAV) were defined in the border region of each of the countries and common actions to be adopted in this area were implemented, comprising a range of approximately 15 km wide on both sides of the border with neighboring countries, affecting specific areas of Argentina, Brazil, Bolivia and Paraguay [17].

d) Work protocol carried out in the foci of foot-and-mouth disease in the border region of Mato Grosso do Sul.

In the national territory, the notification of suspected vesicular disease is compulsory and should be informed immediately to the SVO, within a maximum of 24 hours, and the SVO has a deadline of 12 hours for the first surveillance. Notification can be made by any citizen, through communication channels available to the public [3].

The direction and procedures for the investigation of suspected cases of vesicular disease and in probable cases of foot-and-mouth disease are established in manuals and the prohibition of property is one of the immediate procedures. If there is confirmation of the suspicion of foot-and-mouth disease, the actions should follow the contingency plan for foot-and-mouth disease [3].

Upon receipt of a notification the veterinarian performs the following procedures [18], as follows.

1ª Record of the notification

The first record of the notification of suspicion immediately in the book of sanitary occurrences with at least, with the guarantee of confidentiality if requested by the notifier, such as date and time of notification, type of notifier (owner, third party or surveillance), name of the notifier (where relevant, include surname), telephone to contact of that notifier; identification of the place where the animals with suspected vesicular disease are located, identification of the public person service who received the notification, brief description of the notification (including species involved), other observations considered relevant, and the date and time of departure for the service.

Remembering that guidance should be made on the biosafety procedures necessary to prevent the spread of the possible infectious agent, especially regarding not moving sick animals and their direct contacts and not entering any other property with susceptible animals until the result of the care to be performed by the official veterinary service [18].

2ª Initial survey of information

Evaluations of the information available in the registration system or in the health record of the state veterinary service, such as the existing herd, intensity of movement of animals (entry and discharge in the last 30 days), date of the last vaccination, geographical location and access routes. It is also important to collect information and identification of bordering properties and related properties (with ties in the last 30 days, be it their admission and/or

their graduate) with the property with animals under investigation. Also obtaining information from other properties belonging to the same owner. It is searched for its approximate location (Fig. 2) and identification of nearby properties. All this without compromising reaction time. The priority is to arrange the visit [18].

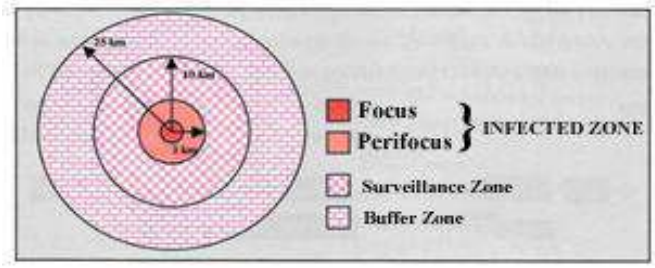

Fig. 2: Schematic representation of the risk areas established around the outbreaks

3ª displacement to the service to the notification received.

In parallel to the survey of the initial information, it is provided the preparation of the vehicle for travel and kit to meet suspected vesicular disease. The staff and the immediate superior were informed of the time and reason for the departure. The FORM-IN (today we have the e-Sisbravet) is filled in, with completion of the final version after returning to the office [18].

4ª Shares in the property.

Arriving at the property with suspicious animals, with care related to biosafety and attention to research, interview and clinical inspection of animals [18].

Confirming the possibility of vesicular disease, the veterinarian should pay special attention to the activities of harvesting material for diagnosis, gathering information and biosafety, the time interval between the confirmation of suspicion and the result of laboratory tests of paramount importance that should be administered considering the possibility of being foot-and-mouth disease. Depending on the quality of the material collected, after entering the laboratory, the initial result can be presented in less than 24 hours [18].

In the collection of diagnostic material, the impossibility of making a differential clinical diagnosis of vesicular diseases, associated with the frequent lack of epidemiological information at the beginning of investigations, requires laboratory support to confirm the diagnosis [18].

Considering, the possibility of being foot-and-mouth disease in biosafety activities, the period between the confirmation of clinical suspicion and the waiting for laboratory results is extremely important. In areas where vaccination is not performed, the disease can spread rapidly horizontally among susceptible animals. In most cases, transmission occurs after direct contact between infected and susceptible; a large amount of virus is found in all secretions as well as in aerosols for 1 to 3 days before and 7 to 14 days after the appearance of lesions and, in vaccinated animals, the elimination of the viral agent has not been recorded before the appearance of lesions [18].

Less frequently, the virus is mechanically diffused between infected and susceptible animals through animal products, instruments (fômites), vehicles and people. Biosafety measures are part of the set of activities used to avoid or minimize the risks of spreading the disease, and several procedures are still being used in the property where suspicion has been confirmed:

In the issue of biosafety, special attention should be given to disinfectants to be used in different situations. Based on the Manual of Procedures for The Care of Occurrences of Foot-and-Mouth Disease and other Vesicular Diseases of PANAFTOSA, where information is presented regarding the procedures to be used in cleaning and disinfection work in different phases of veterinary emergency actions and list of chemicals that can be used in disinfection [18].

Biosafety measures are part of the set of activities used to a void or minimize the risks of spreading the disease, and several procedures to be used, even on the property where suspicion was confirmed, after the collection of samples, all disposable material should be collected by placing them in plastic bags and providing the cleaning and disinfection of the rest of the material, which should also be properly packaged, go to the place where the interview with the owner or direct responsible for the management of the animals will be complemented; change clothes, also keeping the overalls and boots in appropriate plastic bags, tilling interdiction term and pass, clearly and objectively, the guidelines in relation to the care to be taken to avoid the diffusion or aggravation of the health problem. Local veterinary units should have interdiction and disinterdication forms for ready use. The interdiction term should contain the reason for its application, its legal basis, space for signature of the owner or responsible for the herd and the main prohibitions established [18].

The main guidelines and prohibitions that should be applied, especially to issues such as property size and predominant livestock production system, stand out to prohibit the sale of property of animals and products at risk for the spread of foot-and-mouth disease. Also included are non-susceptible animals, in view of the risk of mechanical

transmission of the disease, products not directly associated with risk of spreading the disease may spread it mechanically, and all measures should be taken to disinfect the means of transport and packaging material of these products, and work with tractors and machinery that may increase the chances of mechanical dissemination of the disease should be suspended, leave the lot with cases of the disease under the responsibility only of a small group of workers who will not be able to have access and contact with other susceptible animals of the property, guide those present who do not visit other properties with susceptible animals and do not maintain contact with other people who also deal with susceptible animals (this conduct should be more rigorous for those people who have maintained direct contact with sick animals).

Visits by any person without authorization, including veterinarians, technicians working with artificial insemination and other professionals and producers, especially those who have contact with susceptible animals, are also forsauly, as to whether milk production should be retained on the property. Do not use this product and dairy products in the feeding of susceptible animals (especially calves and pigs). The issue of milk is very important, not only because of the risk directly represented by the product, but mainly because of the risk of mechanical diffusion through the transporter truck and the people dealing with its harvest. Regardless of the quantity produced, the removal of the property may not be authorized as long as the risks of spreading the disease persist.

Even knowing that it is a measure that involves several economic and social issues, it should be considered that milk has low unit value and it is often safer to recommend its destruction, with compensation to the producer. Alternatives to be used and recommended in relation to this product include the destination for the manufacture of products subjected to thermal processing (mozzarella, curd, among others) within the property, the consumption of milk of healthy animals, after boiling for at least 5 minutes and destruction, using chemicals that lead to pH change (e.g.: vinegar or caustic soda), discarding the product in open ditch for this purpose. Do not spill the product into rivers or other water collections [18].

Basic cleaning and disinfection measures for entry and exit from sites with suspected infectious vesicular disease [18].

For the team of professionals (fig. 3) these measures are, at the entrance of the supposedly infected site, wear the appropriate clothing, prepare disinfectant solution, bathe the boots with the disinfectant solution (fig. 4). When leaving the premises, wash and disinfect the boots, remove the used clothes and put them in a plastic bag. Like the material used in animal inspection and sampling activities, disposable materials should be placed in other plastic bags for further destruction [18].

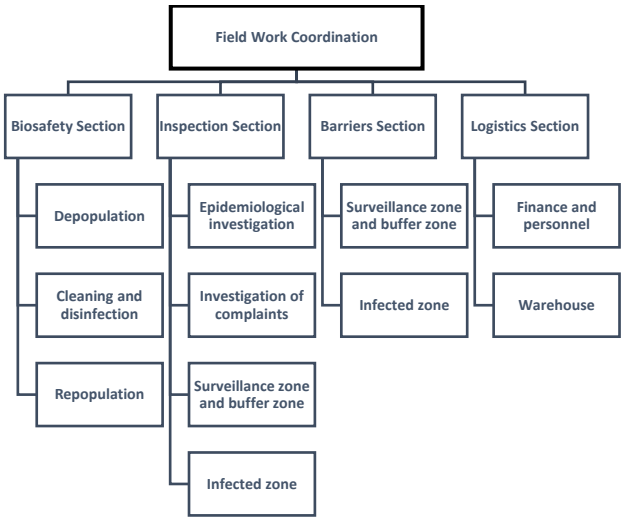

Fig. 3: Field Work Coordination

Fig. 4: People disinfection work

For the vehicles used (fig. 5), you must clean and disinfect pedals and floors, wash the tires with disinfectant solution and go directly to the local veterinary unit [18].

Fig. 5: Vehicle disinfection work

In each identified focus, independent risk and safety areas, represented by the infected, surveillance and buffer zones, should be delimited. After defined actions, with the objective of the complete elimination of the disease, activities of depopulation, cleaning/disinfection, sanitary void, introduction of sentinels and restocking were carried out [18].

In the areas of focus, the sick animals of direct contact, are destroyed using the sanitary rifle method, inside the property and obeying the legal rules. The animals with indirect contact were sacrificed using the Sanitary Slaughter method in refrigerators with federal inspection service (SIF), not eligible for export [18].

Actions were taken in the 1998 focus (fig. 6), according to archives of the Agency for Animal and Plant Sanitary Defense- IAGRO.

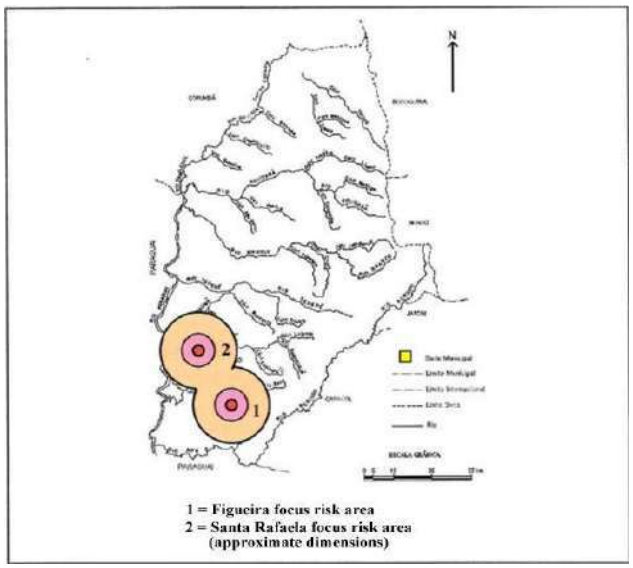

Fig. 6: Schematic representation of risk areas for each identified focus in Porto Murtinho, MS, 1998.

In the Focus (fig. 7 and fig. 8), signs were placed "FORBIDDEN ENTRY - FOCUS OF AFTOSA FEVER...", depopulation, cleaning/ disinfection, sanitary void, introduction of sentinels and repopulation, cleaning and disinfection of all material used in the work, such as vehicles and clothing, specific clothing was used to enter the properties, being used, baged, washed in a washing plant, with the acquisition of washing machines, access to outbreaks was limited, and focus workers were prevented for 72 hours of visiting other properties with susceptible animals.

Fig. 7: Door of the Figeira's farm (index focus)

Fig. 8: Door of the Santa Rafaela farm (Second index focus)

In the Perifoco, clinical inspection was carried out, avoiding the movement of animals, remaining in quarantine, the evaluation of the vaccination history, compulsory vaccination, the collection of blood serum samples in bovines under the age of two years to evaluate the viral activity were carried out. , the re-registration of all properties using the GPS, preventing the transit of susceptible animals, their products and by-products, clarification to owners and pedestrians about the symptoms of the disease, procedure and care necessary to reduce the risk of infection in their herd and the epidemiological survey in search of information for clarification.

In the Buffer Zone and Surveillance Zone, the actions taken were the inspection of susceptible animals with evaluation of the vaccination history, compulsory vaccination in the Surveillance Zone, the collection of blood serum samples in cattle aged less than two years to verify viral activity, the reregistration of all properties using GPS, the impediment of the transit susceptible animals, their products and by-products, the clarification to owners and

pedestrians about the symptoms of the disease, procedure and care necessary to reduce risks of infection of their herd and also conducted epidemiological survey in search of information for clarification.

The actions carried out in the 1999 focus, according to iagro archives of 2000 (fig. 9 until fig 19), are similar to those of 1998, differentiating only the geographical space.

Fig. 9: Photos of lesions characteristic of vesicular disease of cattle in the 1999 focus.

Fig. 10: Photos of lesions characteristic of vesicular disease of cattle in the 1999 focus.

Fig. 11: Animals sacrificed with a positive diagnosis for vesicular disease

Fig. 12: Raising cows for disposal of contaminated carcasses.

Fig. 13: Burial of contaminated carcasses

Fig. 14: Preparation of disinfectant solution

Fig. 15: Vehicle with disinfection solution

Fig. 16: Corral disinfection on one of the properties

Fig. 17: Agents of the State Agency for Animal and Plant Sanitary Defense of Mato Grosso do Sul in field work

Fig. 18: Sanitary education work with rural producers

Fig. 19: Animal captured for material collection

The figures below show the map containing the delimitations (fig. 20 and fig. 21) and regions worked in the 1999 focus, contained in the Archives of IAGRO[19].

Fig. 20: Map with area boundaries

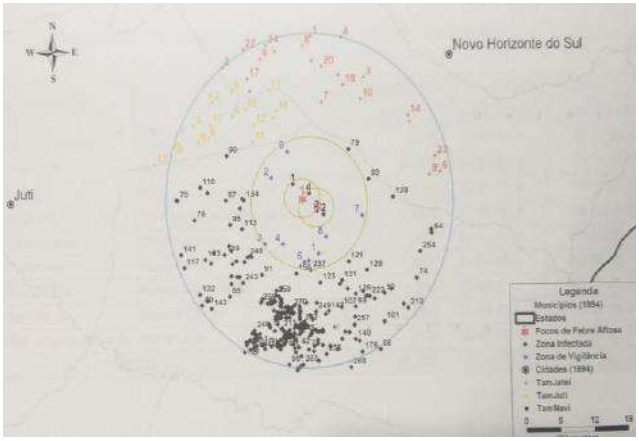

Fig. 21: Map with area boundaries

Among the actions already listed in the previous focuses, the actions of 2005-2006, where there were 33 outbreaks, according to IAGRO archives of 2006, were the interdiction of the Infected Zone, depriving animal owners of their right of free administration of the goods that are in the infected zone, isolation, quarantine, restriction of the movement of animals - no animal left, in the Perifocal Area susceptible animals, were in complete quarantine for up to 30 days, after the elimination of the animals from the focus, the concentration of animals were prohibited fairs and the like, there were various restrictions, of animals destined to refrigerators (30 days without symptoms, have remained on the property for 3 months, 10 km around the origin, for 3 months without foot-and-mouth disease, accompanied boarding), washed vehicles, non-export of meat, meat treatment in accordance with the OIE Animal Health Code; the prohibition of the departure of animal remains, hay, bed, manure, objects, vehicle, etc., the exit of tubers, fruits and vegetables would only occur with special authorization, live birds could not be marketed, only dead, plucked, without viscera, without head and paws, and the eggs could only leave the said area, in packages that allowed disinfection.

Sanitary measures carried out in the outbreaks of 2005-2006, sanitary barriers, sanitary rifle (fig. 22), burial.

Fig. 22: Animals sacrificed with the disease

Due to the number of outbreaks, restrictive factors and sanitation time, animosities (fig. 23 until fig. 25) were recorded from the local population of the affected municipalities in the 2005-2006 outbreaks.

Fig. 23: Popular surround health inspection vehicle

Fig. 24: Popular people overturn IAGRO vehicle as a form of protest

Fig. 25: Popular people interdict access road to the city

e) The Agency for Animal and Plant Sanitary Defense - IAGRO.

IAGRO is the Animal and Plant Sanitary Defense Agency of the State of Mato Grosso do Sul, responsible for performing the Official State Service, being subordinated to the Federal Official Service of the Ministry of Agriculture, Livestock and Supply [20]. It has a Central Unit, located in the municipality of Campo Grande, seventy-eight Local Units, distributed in the seventy-nine municipalities of the State (Corumbá and Ladário divide the same Local Unit), which are divided among eleven Regional Units [21].

The Agency was created under the qualification of The Department of Agricultural Inspection and Defense of Mato Grosso do Sul (IAGRO), by Decree-Law No. 9, of 01/01/1979, already on 10/26/2000 received the current name, State Agency of Animal and Plant Sanitary Defense. And on 12/24/2014 the Government of the State of Mato Grosso do Sul sanctioned State Law Nº. 4,640, defining in the organizational structure of the State The IAGRO as an autarchy, with the purpose of implementing public policies of inspection and inspection, complying with and complying with the obligations of the laws in force, with the objective of safeguarding agricultural health and the economy of the State [21].

This work was carried out with the objective of conducting a study on the actions performed by IAGRO in emergency care for the elimination of outbreaks of Foot-and-Mouth Disease in the State of Mato Grosso do Sul, considering the importance of the geographical characterization of the state border region in the study of the epidemiology of the disease.

II. MATERIALS AND METHODS

a) Research Design

The survey carried out in this study regarding its nature has a qualitative approach, since a bibliographic survey of all information regarding the outbreaks of Foot-and-Mouth Disease in the border region of the State of Mato Grosso do Sul was made.

The research was delineated through a case study, making a survey with depth, related to a given case or human group in all its aspects. However, this may be limited because it is restricted to the case studied, which cannot be generalized [22].

The research is characterized as exploratory and explanatory, providing greater familiarity with the problem and identifying the factors that determine or contribute to the occurrence of phenomena [23].

To develop this work, articles, regulations, public archives and official reports were researched, in short, a compile of materials related to the subject was carried out for retrospective study of foot-and-mouth disease virus in regions of international borders of the state of Mato Grosso do Sul, the object of this study.

b) Collection and analysis of documents

The data collected from the outbreaks of Foot-and-Mouth Disease that occurred in the State of Mato Grosso do Sul were produced through records in case books and official reports of public person service that were in the coordination of the actions of the teams that acted directly in the foci. All material cited is filed with the Division of Animal Sanitary Defense, in IAGRO Central. Its content includes all the records of the actions in the outbreaks, as well as the guidelines and activities carried out throughout the State until 2006.

In the period established between June 2006 and April 2007, the Animal Health Surveillance System (VISAN) was responsible for recording animal movement, through the issuance of the Animal Transport Guide (GTA), and also for vaccination records of the state herd. This computerization system was internally accessible, that is, only from IAGRO's public persons service.

The data published in the 2008 PNEFA/DSA/MAPA Annual Report were extracted from IAGRO's monthly reports and, provided every six months to MAPA for the preparation of the Annual Report pertinent to this Department.

III. RESULTS AND DISCUSSION

In 2005, the State of Mato Grosso do Sul (MS) suffered a great economic and social impact when the presence of foot-and-mouth disease virus, serotype O, by IAGRO was detected in the municipalities located in the south of the state (Japorã, Eldorado and Mundo Novo), a region with an international dry border with Paraguay, and there is also a reflection in five municipalities of the State of Paraná (PR).

As described in the Ebook MAPA 2021, after the detection of outbreaks in MS and PR, there was the suspension of the condition of Free Zone in these two States and in ten other Units of the Federation that were part of the Free Zone of Foot-and-Mouth Disease with Vaccination, which were the States of the Federal District, Goiás, Espírito Santo, Bahia, São Paulo, Rio de Janeiro, Sergipe, Tocantins, Minas Gerais and Mato Grosso, which resulted in the closure of cattle trade with OIE member countries [24].

The method used to eliminate outbreaks was based on the elimination of animals susceptible to Foot-and-mouth disease existing in the foci and herds related to them by direct or indirect contact, and on the prohibition of trade and movement of susceptible animals and products at risk for foot-and-mouth disease according to the Annual Report 2008 PNEFA/DSA/MAPA, with indemnification to animal owners eliminated.

According to the Partial Report of the actions adopted for the elimination of outbreaks of foot-and-mouth disease in the municipalities of Eldorado and Mundo Novo - MS/Period: October 2005 - October 2006, prepared by GEASE (2006), initially the safety zone with a radius of 25 km was created around the foci. These zones were divided into three sanitary areas, being: Infected Area (3 km from the focus); Surveillance Area (7 km from the infected area) and Buffer Area (15 km from the surveillance area). In the study by Goulart (2014) mentions that the municipalities of Eldorado, Mundo Novo, Japorã, Itaquiraí and Iguatemi were banned because they had properties within the safety zone, as an area of health risk; and the transit of animals was prohibited in these municipalities mentioned, authorizing only animals for slaughter aiming at internal consumption.

The transport and marketing of products and by-products of animal origin, in addition to the movement of animals, within a radius of 25 km of the foci properties was prohibited. Subsequently, these measures were prolonged for two years.

In addition to the transit of live animals, the activities to control the state's health emergency for the eradication of foot-and-mouth disease virus in the safety zone, was described by Goulart (2014) in five stages, initially: depopulation (herd slaughter); cleaning/disinfection; sanitary void (established a period of thirty days without animals); introduction of sentinel animals and repopulate (gradually the animals were reintroduced) [25].

After the depopulation work, a population-based serological study and sampling methodology in the remaining herds of the banned municipalities was carried out, as presented in the 2008/PNEFA/DSA/MAPA Annual Report, in order to verify the absence of foot-and-mouth disease virus circulation in the herd. From March to August 2006 and from October 2006 to January 2007, two seroepidemiological studies were conducted covering 826 properties and 21.396 samples, according to the guidelines established by the OIE.

The results of the study did not allow to rule out the occurrence of viral circulation in the restricted area: Eldorado, Japorã and Mundo Novo. It was concluded that the zoosanitary measures were sufficient to prevent the diffusion of the viral agent out of the three interdicted municipalities, but were not effective to contain its circulation between the properties within the affected municipalities. In this context, and because it is a serological study involving random sampling, the 2008 PNEFA/DSA/Mapa Annual Report shows that the final result referred to the entire target population of the epidemiological survey and not only to the properties that were part of the sample. As a course, these municipalities remained closed due to existing viral circulation.

A number of cattle were preemptively sacrificed from 118 properties. The owners of the animals were compensated for the difference between the value of the animals and the amount paid by the refrigerator, totaling US$ 7.966.050.00. This preventive slaughter was finalized on June 21, 2007, according to the 2008 PNEFA/DSA/MAPA Annual Report.

The Annual Report 2008 PNEFA/DSA/MAPA shows that in 2007 a seroepidemiological survey was conducted with the objective of evaluating the circulation of foot-and-mouth disease virus in the state. For this, the State was subdivided into four subpopulations. Restricted Area, in the Regions of the Plateau, Pantanal and Border. The study was conducted in 2.046 rural farms in cattle between 6 and 12 months of age, totaling 34.699 cattle. Of these properties, 1.150 primary sampling units were constituted, and in each of them, an average of 30 blood serum samples were collected, in addition to clinical inspections in mouths and paws of all animals.

Also in this same document, the 2008 PNEFA/DSA/MAPA Annual Report, the results of the complementary investigations and the evaluations that were conducted in the primary units, with seropositive cattle, were satisfactory to, based on the established decision criteria and sample parameters used, to demonstrate the absence of viral circulation of foot-and-mouth disease virus in the State of Mato Grosso do Sul. On November 6, 2007, MAPA considered closed the sanitation work of the foci of Foot-and-Mouth Disease registered in the State of Mato Grosso do Sul, based on the official results obtained through the serological survey.

These actions resulting from Iagro's actions were paramount for the subsequent creation of the High

Surveillance Zone (ZAV), in the regions of international border between Brazil and Paraguay and, Brazil and Bolivia, to maintain and protect the health of the herds as well as the economy of the State of MS, through ORDINANCE/IAGRO/MS Nº1,420, of 21/01/2008, amended by Portaria/IAGRO/MS Nº 1.758, DE 03/03/2009 [26][27]. ZAV obtained its recognition as an area free of Foot-and-Mouth Disease with vaccination, through Normative Instruction of the Ministry of Agriculture No. 13, of 03/21/2011[28].

According to Goulart (2014) the main measures of ZAV were the identification with numerical earrings of all sheep and goat herds; the issuance of Animal Transport Guides (GTAs) to accompanied shipments, as well as the supervision of fixed barriers and steering wheels, resulting in total control in animal traffic; the quarantine requirement for animals carried over and to be carried; vaccination against foot-and-mouth, by means of the official needle, carried out by the official organ IAGRO and; serological surveys[25].

The Agency has reformed the surveillance methodology by intensifying surveillance in strategic locations and deploying surveillance in "quadrants". The quadrants contributed to the resizing of health surveillance actions, which were carried out by quadrants directly meeting the two demands coming from the federal sphere (MAPA), with a certain degree of correlation between them, being the first pertinent to the attendance to the PNEFA - Strategic Plan (2017-2026) that aims to lead states to change the health status of free of Foot-and-mouth disease with vaccination, for the free of Foot-and-mouth disease without vaccination and the second, to attend to the fundamental components of QUALI-SV, complying with Normative Instruction Nº. 27, of 07/17/2017[29].

There is another redesigned and intensified system, animal traffic surveillance and animal products. In 2020 mobile surveillance data, according to the e-Saniagro/IAGRO database, show that 91.098 cattle and 336 buffaloes were inspected throughout the state of Mato Grosso do Sul, distributed in 3068 surveillances. Of the tax actions applied, including all species of production animals, 59 records of infractions were drawn up and a fine for transit without GTA.

IV. CONCLUSION

The outbreaks of foot-and-mouth disease in Porto Murtinho in 1998, in Naviraí in 1999 and in the years 2005 and 2006 in the municipalities of Eldorado, Japorã and Mundo Novo, expose three moments lived in an interval of 8 years, which allowed a transformation in the productive system of the State of Mato Grosso do Sul and also, structuring of animal health institutions. Such situations have changed the awareness of the producing class, that the work is not only the responsibility of IAGRO, but also of the entire meat production chain, culminating in the economic success of this market. The State of Mato Grosso do Sul has been without a foot-and-mouth disease outbreak for more than 15 years and the international border region has been vaccinated for more than 99.2 years, including in the South Mato Grosso pantanal region.

Conducting a study on the foci of foot-and-mouth disease and characterizing the border region of the State of Mato Grosso do Sul is the objective of this study, which serves as a reference to maintain and improve health surveillance measures substantially in these regions. These inspections take place throughout the state, however, in the border region must be optimized every year, so that Mato Grosso do Sul achieves the goal desired by IAGRO and also throughout the production chain, the status of foot-and-mouth disease-free area without vaccination.

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Internationalization of the Chemical Engineering Course at the Federal University of Latin American Integration: Challenges and Possibilities

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Abstract*—*In order to understand the challenges, possibilities, and achievements of the chemical engineering course in Latin America, this article addresses the characteristics and difficulties of implementing the internationalization process in this higher education institution. This study is based on documentary information, as well as student testimonials. The Federal University of Latin American Integration (UNILA) aims at academic exchange and solidarity cooperation with Mercosul member countries and other Latin American countries. Among the numerous institutional challenges, there is the consolidation of bilingual teaching staff and the sociocultural and linguistic difficulties of adaptation for foreign students. This article shows that the barriers to adaptation are diverse and complex but have been constantly identified and solved over the six years of existence of the course, also shows the importance of the internationalization process of Latin American universities.

I. INTRODUCTION

The Federal University of Latin American Integration (Unila) has, as its vocation, the academic exchange and solidarity cooperation with Latin American countries (Brazil, 2019).

In its mission, Unila aims to train human resources able to contribute to Latin American integration, regional development and cultural, scientific and educational exchange of Latin America, especially the Mercosul, and for this, 50% of vacancies of all undergraduate courses are reserved for students from Latin America and the Caribbean. In 2019, around 30% of the vacancies were for foreign scholars (Unila, 2020) and the remaining vacancies were available for Brazilians.

In this way, internationalization is inherent to Unila and is part of its identity, as it offers a type of horizontal cooperation (it happens for the benefit of both parties involved) and, central (it incorporates the international dimension into the university objectives and functions) (Abba, 2016).

This paper addresses the chemical engineering course, analyzing students from 32 countries (Unila, 2020). These students, besides forming the academic community of UNILA, they promote the cultural enrichment of Foz do Iguaçu city, which is also multicultural, formed by approximately 80 nationalities (Prefeitura Municipal de Foz do Iguaçu, 2020) and is located in the triple border between Brazil, Paraguay and Argentina.

In 2015, twelve courses were created at the University of Latin American Integration (Unila), among them, the Chemical Engineering course (Brazil, 2019), which is inserted into the academic, political and geographical

context mentioned above. It is from this context that this paper aims at addressing the issue related to the adaptability of foreign students and teachers, as well as discussing on the challenges to internationalization and also the main institutional challenges. In order to achieve this purpose, bibliographic and documentary research resources were used, at UNILA's Information and Institutional Regulation Coordination Office, as well as the testimonials of the graduates.

II. RESULTS AND DISCUSSION

2.1 Course Overview and Students' Challenges

The Chemical Engineering degree program enrolled 264 students of 14 nationalities from its creation until the first semester of 2020. Table 1 shows the nationalities of the students on Unila's Bachelor Chemical Engineering Program. The course is formed by a majority of 189 Brazilian students, followed by the Paraguayan community, with 53 students (18.3%), besides the other two communities that are Haitian (16 students or 5.5%) and Colombian (11 students or 3.8%), which are also numerically relevant.

The data presented in Table 2 were obtained from annual reports, generated by the university information system and made available for the coordination of the Chemical Engineering (CE) Course at the Unila.

In the first semester of admission to the Unila, the Additional Basic Portuguese/Spanish course is compulsory. Thus, while Brazilian students must attend Spanish classes, the foreign students must attend Portuguese classes. Table 2 shows that students have occasional difficulties while attending these courses, even more so for Brazilians, in Spanish, than for foreigners, in Portuguese.

As internationalization requires this coexistence of academics of different nationalities, to minimize the initial language barrier, Unila offers an online Spanish-Portuguese course (CEPI-Unila). In this course, the target audience are students who have been accepted to the university and aim to get familiar to the Portuguese and Spanish languages. However, as these courses are optional, many students have their first contact with the Portuguese/Spanish language while they are attending classes from other course subjects, which are mostly taught by Brazilian lecturers. Proficiency on both languages is not a mandatory requirement for neither teachers nor the administrative staff.

Table.1: Nationalities of the students in the Chemical Engineering course at UNILA.

Nationality	Year of Entry						Total
	2015	2016	2017	2018	2019	2020	
Argentine	0	0	0	0	1	0	1
Bolivian	3	1	0	0	0	0	4
Brazilian	25	29	32	37	40	26	189
Chilean	1	0	0	0	0	0	1
Chinese	0	0	0	1	0	0	1
Colombian	0	3	3	0	3	2	11
Cuban	0	0	1	0	0	0	1
Dominican Republic	0	0	0	0	0	1	1
Ecuadorian	0	0	0	0	0	1	1
Haitian	11	1	0	0	1	3	16
Honduran	0	0	0	0	1	2	3
Panamanian	0	0	0	0	0	1	1
Paraguayan	10	11	10	13	5	4	53
Peruvian	0	1	1	0	2	1	5
Salvadoran	0	0	0	0	0	1	1
Venezuelan	0	0	0	0	1	0	1
Total	50	46	47	51	54	42	290

The foreign students who started in 2015 were pioneers and, thus, pathfinders of the language and the culture, and they are responsible for the first academic customs. Furthermore, they had to adapt to the city of Foz do Iguaçu, learn about the university's administrative structure, discover the bureaucratic intricacies of documentation and visas for staying in the country, among other difficulties inherent to the internationalization process. Therefore, they had greater difficulties to overcome at that year, and no veteran students of the same course to give them support. Thus, these students showed a higher failure rate than the Brazilian students, what can be seen in Table 2.

The increase in approvals of Brazilian and foreign students over the years is probably due to the increased interaction between students, the knowledge of the administrative structure of Unila, the knowledge of the local culture, communication and information networks created for problem solving, the improvement of pedagogical approaches of teachers, aimed at foreign students, as well as the improvement of the reception of these students, by Unila and by the creation of a student directory, consolidated in 2018.

Table.2: Failure of newcomers in the 1st semester subjects of the CE Course.

Discipline		Disapproval per year				
		2015	2016	2017	2018	2019
Introduction to Chemical Engineering	B	6	5	4	2	18
	F	18	2	4	2	3
Analytical Geometry	B	10	14	15	15	32
	F	23	16	12	11	9
Portuguese/Spanish Additional Basic	B	2	3	2	2	14
	F	0	1	3	1	0
General Chemistry	B	8	8	5	9	18
	F	21	4	8	8	8
Experimental General Chemistry	B	5	7	4	5	18
	F	14	5	6	8	7
Foundations of Latin America I	B	1	2	3	2	8
	F	0	1	2	1	1
Technical Drawing	B	2	3	2	0	12
	F	6	4	4	0	0
Pre-Calculus	B	3	15	9	*	*
	F	18	15	7		

Brazilians (B), Foreigners (F), * Removed from the grid

The selection process for foreign students at Unila has been carried out through the internet since 2016, which contributed to broadening the dissemination of this process, in addition to enabling any student from Latin America to apply for a course, following the rules of the announcements of the International Relations department (Proint/Unila).

Internationalization is not an immediate process neither in a university, nor in a course, since it involves a process of institutional learning, a correction of actions and an adaptation of internal processes over the time (Abba &Corsetti, 2016), as has been performed at Unila during these years.

2.2 Internationalization from a Student Perspective and the Latin American Job Market for Chemical Engineers

According to the Boston Consulting Group, 26% of all companies, with more than US$ 1 billion in revenue and located in Latin American countries (Multilatinas), are Brazilian companies, therefore, there is interest from many companies in profiles of professionals with communication skills besides language knowledge, as well as knowledge about the Latin American market. Multilatinas are strong contributors to productivity, investment, innovation, and job creation and will continue to boost Latin America on the international scene (Aguiar et al., 2018).

Therefore, there is a demand for professionals with competitive skills to work in Multilatinas. In this context, the multicultural knowledge that Brazilian culture and the UNILA provides, combined with the process of bilingual education, is a differential for academics trained by the institution, contributing to the process of integration of Latin America.

Below, we present some excerpts of statements from CE students (A1, A2, A3, A4 and A5) in which these students describe how the Unila's internationalization process can influence the development of skills and promote insertion in the LA job market.

The academics who participated in the study are part of the first year of the course (2015), are Brazilians and foreigners, some of them have developed scientific initiation activities, extension projects, academic mobility and participated in the course student directory.

The academic A1, in his statement, explains the relevance of multicultural experience, the ability to manage people and conflicts, the communication and integration apprenticeship, as transcribed below.

"[...] the process of internationalization of the Unila is a strong point that deserves to be highlighted in our training, for allowing us to immerse ourselves both in the cultures and in the learning of new languages, the conflict management. As foreigners, we learned to mingle with others, integrate and develop new skills concerning people management, even without having taken any specific course related to this. [..]" (A1, 2020)

According to A2, the course was also an opportunity to live with people from different cultures and to learn the Spanish language.

["I found it great to know different cultures... I had the opportunity to learn a little bit from each of my colleagues who were not from Brazil, it helped me a lot with the issue of the Spanish language... [..]" (A2, 2020)

For A3, the experience in a multicultural environment made it easier the professional relationship with people in the work environment (during the internship).

"[...] the environment with mixed cultures added a lot of knowledge either in my academic or personal life, especially in the work environment as the internship, in which the professional relationship with different people becomes easier and respectful, promoting a better harmonization in the work environment [...]" (A3, 2020)

A4 believes that Unila enabled his personal development, mainly associated with the interpersonal relationships in a multicultural environment.

"[...] made me grow a lot as a person, respect others and their different cultures, as well as this is a differential aspect we incorporate when it happens, we have to work in an industry, because the interpersonal relationship counts a lot. [...] Unila is like living in other countries "without leaving home" [...]" (A4, 2020)

For A5, Unila provided him with numerous possibilities and experiences, such as the challenge he faced when chose to leave a more traditional Brazilian university to study at the Unila, a new university with a course under implementation. Another aspect was the opportunity for having contact, on Brazilian soil, with native Spanish speakers and their cultures, as well as the experience of adaptation in another country, through academic mobility.

["It was a choice for me to change the old university to face this new challenge. [I already had contact with the Spanish language [...] however, I had never had contact with native people [...] The highlight was the exchange opportunity, with Spanish [...] to one of the most sought-after universities in exchange in Latin America, UNAM (México). After that, I went in search of internships [...] I got two jobs in multinationals, both were very interested in the purpose of the Unila [...] One of the companies asked me if I would have problems living with people from other countries, and I believe that the answer was what they wanted to hear: "I have gotten along well with people from other countries since my first year at university. " [...]" (A5, 2020)

The testimonials of the CE Undergraduate Course students were diverse and showed that, while some of them were able to explain the skills and competencies that the Unila's internationalization process enables, others described the distinct opportunities that the university provides.

III. CONCLUSION

The consolidation of Unila, as a plural and democratic university, also goes through the strengthening and construction of technological areas and engineering courses, focused on the interests of the market in line with the Brazilian and Latin American interests. Therefore, investment in education and research focused on technological areas is fundamental for the growth, integration and strengthening of universities, industry and the economy in Latin America.

The statements of the CE students showed that students were able to identify the skills and competences developed, which are a differential of The Unila, for insertion into the world of jobs, while others described the opportunities that the institution provided. Among the skills mentioned, both explicitly and implicitly, was the improvement in the ability to deal with language in a professional context in a multicultural group.

Over the six years of the course's existence, it has been possible to verify the existence of problems that have hindered the effective fulfillment of the Unila's mission, such as the lack of care with bilingualism at the Unila due to the lack of preparatory courses being offered, as well as student selection criteria that evaluate prior knowledge of Spanish or Portuguese, and also the lack of policies to foster professors bilingual formation.

However, despite the difficulties pointed out, it can be observed that there has been a drop in failure rates at the first semester subjects over the years, indicating that the students have some support from the institution and are making a difference in the process of inclusion and belonging, both inside the Unila and after graduating, with the insertion of these engineers into the Latin American job market. The internationalization process of the Unila's Chemical Engineering course proves to be viable and successful in training professionals.

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Implementation of active teaching and learning methodology in the nursing course at a higher education institution: Literature review

Implantação da metodologia ativa de ensino e aprendizagem no curso de enfermagem em instituição de ensino superior : Revisão de literatura

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Abstract*— The active methodology or modern methodology is a type of learning that has a broad process with the main characteristics of the insertion of the student/student, being him the fundamental piece or the main primordial agent for the learning itself. It's different from any other methodology, that is, and unlike anything we've learned in the traditional way. The aim of the study is to relate issues related to active methodology and how it has been accepted in the daily lives of students in higher education institutions. The methodology and literature review type focusing on the main Brazilian health journals, the bibliographic surveys included publications in LILACS, BDENF, MEDLINE, SCIELO, BVS and REBEN databases from 2010 to 2019. of the methodology as used throughout the research, which shows that as the nursing student is not financially dependent and has to work to maintain the course, acceptance, performance, and line of reasoning can still be a milestone to be studied, as it still lacks more studies in relation to nursing. The higher education institution in Cacoal-RO has not yet fully consolidated, but it already has results showing that its real influences on the teaching and learning process have consequently been using new paradigms in the practice of teaching..*

Resumo *— A metodologia ativa ou metodologia moderna é um tipo de aprendizagem que possui um amplo processo com principais*

características da inserção do discente/estudante sendo ele a peça fundamental ou o principal agente primordial para a própria aprendizagem. É diferente de qualquer outra metodologia, ou seja, e diferente de tudo que aprendemos de forma tradicional. O objetivo do estudo é relacionar assuntos referente a metodologia ativa e como ela vem sendo aceita no dia a dia dos discente nas instituições de ensino superior . A metodologia e do tipo revisão de literaturas com enfoque nas principais revistas brasileira de saúde, os levantamentos bibliográficos incluíram as publicações em bancos de dados LILACS, BDENF, MEDLINE, SCIELO, BVS e REBEN entre o período de 2010 a 2019. Concluir que a implantação da metodologia conforme empregado no decorrer da pesquisa, que mostra que como o aluno de enfermagem não é dependente financeiramente e tem que trabalhar para manter o curso, a aceitação, o desempenho, e a linha de raciocínio pode ser ainda um marco a ser estudado, pois ainda carece de mais estudos em relação a enfermagem. A instituição de ensino superior de Cacoal-RO ainda não consolidou totalmente, mais já tem resultados mostrando que suas reais influencias no processo de ensino e aprendizados vem consequentemente utilizando novos paradigmas na pratica do ensino.

I. INTRODUCTION

Teaching and learning in Brazil has been driven by traditional teaching methodologies, thus, knowledge on the part of the teacher (professor) is restricted to teaching learning, who by taking on the role of transmitting the line of reasoning to the student (student) makes the same learn peacefully without the much-needed criticisms and reflections of the content being carried out (GOMES & REGO, 2011; MITER et al., 2008).

Currently, where the technological world has gained great prominence in the modern world, there are still needs to be implemented in educational institutions, such as the social role of teachers and professional training so that both will interconnect for better performance in the current world of work (VIANNA, BONDIOLI, 2017).

Over the years, the implementation of the active methodology has been conquering its spaces in the institutions, they have been invited to participate in the transformation, changing their pedagogical methods and increasingly bringing the reality of learning between professors/students closer. having the experience of conquering what he wants for himself (DELORS, 2012; NISKIER, 1996).

By being in a higher education institution, we know that the course lasts only a few semesters, soon that student will conquer the long-awaited graduation, the active methodology has been encouraging the student/professor to allow it, as knowledge can remain for decades and each achievement, knowledge becomes essential, centralizing training and making them become a good professional (DELORS, 2012; NISKIER, 1996).

The aim of the study is to relate issues related to active methodology and how it has been accepted in the daily lives of students in higher education institutions.

II. METHODOLOGY

The research is about review studies, with no need for submission to the Brazil platform or approval by the Research Ethics Committee (CEP) of the higher education institution in Cacoal-RO.

The present work was presented as a descriptive and exploratory study, retrospective observational or experimental studies of recovery and critical analysis carried out through a bibliographic review, with the purpose of analyzing the productions in journals analyzing the articles, dissertations and thesis, about the importance of reasoning looking for key words such as: Teaching; Learning; Active methodology.

The bibliographic research had as a problem question: What is the importance of implementing an active teaching and learning methodology in the nursing course at a higher education institution.

In the inclusion criteria, it was possible to search for articles that sought to explain the definition of the active methodology and also based on key words, already published in scientific journals, which could be developed from books, articles and dissertations in Portuguese, English and Spanish, were used to translate the articles into another language, the translator available on the website https://translate.google.com.br/. In the exclusion criteria, everything that was incongruent and had no

connection with the general objective of the research, and asks the problem of the subject.

No data collection instrument was used, as, as reported throughout the text, the study is a literature review, so, not being necessary to use it, all data for the analysis were written in Microsoft Word ®.

It was structured and carried out in the period from May 2019 to August 2019. In this way, the literature review study provided guidance for the researcher in relation to the topic addressed, so that he could create hypotheses and formulate more problems accurate or that can be researched by further studies. Informed consent (FICF) was not used as it is a literature review and does not involve any human beings.

The data contained throughout the article were extracted from a journal available on the internet in a database (LILACS, BVS, SciELO, REBEN) on the subject discussed. Thirty-five articles referring to the topic were analyzed, in the end, 15 articles were evidenced containing publications between the years 2010 and 2019, which had more to do with the objective of the article.

III. LITERATURE REVISION

The active methodology has not yet been fully accepted by many of the students, as it breaks the paradigm of the student being self-taught and still a subject that must be worked on in everyday life in educational institutions. The methodology has already been implemented in some courses, some with one hundred percent of the workload, others still in the adaptation phase. There is always the positive and negative question, the positive that seek knowledge in the use of a search tool and the search for formulating new syntheses. At the beginning, when it was implemented, there was a repercussion, a large part of the students highlighted their reports of doubts, concerns, anxieties, as they left a comfort zone where the teacher passed everything ready to the student and suddenly the student had to seek knowledge by self-taught methods (FERRAZ JÚNIOR et al., 2016).

The experiences in higher education institutions visualized a progression of acquiring security for oneself, where he calmly had to provide confidence to implement the method (LUNA and BERNARDES, 2017).

Like everything new, the great impact of insertion. When implemented, the methodology was always associated with practices, thus providing a better fixation on the subject. The nurse teacher carries out a broad critical reflection on the context employed, going well beyond that, as the student inserted in the active methodology has a broad approach to the topic, and can at any time reverberate with any question associated with the subject, with the teacher being responsible for remedying and remove all doubts related to the approach of the student, in this way the role of the teaching nurse is valued (PARANHOS and MENDES, 2010; GOMES et al., 2010).

In practice, analyzing the effectiveness of implementing the nursing course methodology highlights the challenge for both the teaching professional and the student. The active methodology allows both sides within a higher education institution to analyze the large number of professionals trained through the traditional methodology and now the active one (PARANHOS and MENDES, 2010).

There will always be repercussions, some will question the implementation and prefer the old traditional method, as the convenience is still present in the classrooms, although many students leave to study only in weeks of assessments (LUNA and BERNARDES, 2017).

The nursing course has not yet been fully employed using the active methodology, they are being inserted in stages so that the student can, over the semesters, become increasingly familiar with the new learning methodology. Each year it is evaluated by the group of professors at the institution, thus allowing for adaptation over the years (DIAZ-BORDENAVE and PEREIRA, 2010).

The central focus of the active methodology is that the main objective of the proposal is centered on the student. Thus, the teaching and learning process differs from the traditional method, generating actions for the center of the transmission of knowledge of the teacher/student (SILVA and SÁ-CHAVES, 2010).

The teacher is the center, that is, the transmission conductor for the student, is responsible for granting teaching and learning strategies, being the highest responsible authority in the educational process. The active methodology has become an innovative pedagogical trend, with the emergence of critical pedagogy in which the teacher has the role of mediator by conducting the apprehension of the content, making the educational process be observed and extracted from it, with a transformative, political and social vision (LUCKESI, 1991 apud SOBRAL and CAMPOS, 2011).

Amidst the negative repercussion that emerged at the beginning of the implementation of the methodology in the nursing course, today the acceptance is well balanced, students are already likely to be interested in the new discoveries that the methodology has been employing over the semesters, thus generating positive feedback to the teaching staff of educational institutions (DIAZ-BORDENAVE and PEREIRA, 2010).

When some type of rejection arises, teachers must use strategies to insert the student through groups so that both feel innovated and have developments that can enable the line of reasoning and learning, thus, making the student endowed with knowledge and preparing the even having its own line of reasoning through group discussions (VIANNA, BONDIOLI, 2017).

For nursing, it is understood that teaching methods are still challenging, they demand a lot from students, because, unlike the medical course, where most of them are available to study, and in nursing, many are the students who pay for the course. , having to work during the day and attend at night. Therefore, the student does not have much availability to be engaged in the active methodology to have a good development. In this regard, the teacher must have their role, know each student well and their difficulties, and have a wide variety of activities and strategies to implement and create new teaching situations, as they do not leave the student helpless and bring the same interest and pass on to carry out the possibility of believing and achieving every day the proposal employed by the teacher in the teaching and learning process (WALL, PRADO and CARRARO, 2010).

However, the teacher has a great role to do the essentials, because the critical and methodological planning must be carried out in a conscious way for the actions performed, having to define accessible tools and techniques for the pedagogical and methodological design, discriminated against the learning procedures (ALMEIDA, FERRAZ, 2010).

IV. CONCLUSION

The study, through the analysis of literature published in the main Brazilian journals, can observe that although there is still some acceptance, many professors are enjoying the active methodology and are getting good positive feedback.

There is still no full support from governments and institutions, as the new method is still having difficulty in innovative training from traditional to current changes, thus forcing the teacher to constantly adapt to the active method without providing resources to the Work. Having didactic and essential, professors without didactics, they do not have good acceptance in the classroom, student and curious, and the professor must be prepared for the emergence of extraordinary doubts, therefore, they must overvalue learning, always seeking alternatives that facilitate and enable theories to the individual capacity of the student.

It is observed that the implementation of the methodology as used throughout the research, which shows that as the nursing student is not financially dependent and has to work to maintain the course, acceptance, performance, and the line of reasoning can still be a milestone to be studied, as there is still a need for more studies in relation to nursing. Higher education institutions in Rondônia have not yet been fully consolidated, but they already have results showing that their real influences on the teaching and learning process have consequently been using new paradigms in teaching practice.

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Treatment options for conoid teeth: A literature review

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***Abstract*—** *There are several reasons that can cause aesthetic damage to patients' smiles. Among them are those caused by dental anomalies, where dental anomalies of size stand out, in particular microdontia, which provides the affected teeth with short clinical crowns and often without contact points (conoid teeth). The present study aims to review the available literature regarding the aesthetic and rehabilitative treatment of teeth with reduced size that can be carried out through restorative procedures (direct or indirect) associated or not with other auxiliary treatments, such as orthodontic treatment, for example. The aesthetic characteristics of adaptation to the natural tooth color, ability to adhere to dental tissue, less need for complete tooth removal and the low cost compared to indirect materials are some of the reasons for the great popularity of composite resins. Regarding veneers, as there is no need for much dental preparation before placing the veneers, the conoid tooth does not need to be further compacted or shrunk, however, the cost must be analyzed. The price of resin or porcelain veneers is, for many patients, the decisive factor when choosing the best technique with laminated veneer. The price of resin veneer is, in most dental services, lower than porcelain veneer. The reasons for the lower costs range from the reduced number of consultations and the dismissal of dental prosthesis laboratories responsible for making ceramic laminates. Thus, it is concluded that conoid teeth are changes in size and shape of natural teeth. These changes have an aesthetic effect on the patient's smile, as the affected teeth are smaller than normal and have a sharpened incisal surface; The restorative technique using composite resins presents itself as an excellent alternative to re-anatomize conoid teeth when the treatment is planned and carried out in a detailed manner, and because it is less costly to the patient.*

I. INTRODUCTION

Currently, dental and facial appearance is a major concern for clinicians in the field of restorative dentistry and dental prosthesis, as well as for patients (REZENDE; FAJARDO, 2016). Aesthetic problems are one of the most common reasons for consultations in dental offices, probably because issues related to appearance can influence many aspects of a patient's life, including their personality, physical attractiveness, work and human relationships (OLIVEIRA et al., 2020).

Among the various reasons that can cause aesthetic damage to the smile of patients are those caused by dental anomalies, which are defined as congenital malformations of dental tissues that occur as a result of changes that

affect the natural process of odontogenesis, in which several genes that regulate intervene the process, if altered, can damage the primary or permanent dentition or both, causing delay in the change from primary to permanent dentition and, sometimes, lack of development of the jaws; in addition to affecting characteristics such as number, size, shape, structure and color of one, some or all teeth (LOBATO et al., 2019; REIS et al., 2016; SANTOS et al., 2015).

One of the anomalies that most generate aesthetic complaints due to its characteristics is microdontia, which refers to teeth that are smaller than normal. It is a dental variation that is distinguished by the reduction in the mesiodistal and cervico-incisal diameters (due to coronary alteration or level of the gingival margins) of the dental crown, which is why they are considered small teeth with adequate anatomy. It can occur in a generalized way or in a single tooth, with the upper lateral incisor being the one that most frequently presents changes in size and shape (SILVA et al., 2016).

When the lateral incisors are affected by this anomaly, they will often present a conoid shape, bringing an unsightly result to the patient's smile, but still offering great conditions for the rehabilitation treatment to be successful. Dentistry today offers several treatment options depending on the patient's expectations and the clinician's experience, such as: crowns, dental restorations or ceramic veneers (LOBATO et al., 2019; REIS et al., 2016).

Thus, given the above, the aim of this article is to review the literature on the reanatomization of conoid teeth, focusing on the treatments used with the aim of providing the patient with smile esthetics and harmony.

II. LITERATURE REVIEW

2.1 Conoid teeth

Microdontia has been related in the literature to a hereditary pattern, which is manifested by teeth with a crown smaller than normal in relation to the other elements of the mouth. This means that the root is normally of normal size, although it may be oddly shaped, and that it is the crown part, the visible part of the tooth, that is smaller than normal. Microdontia is divided into localized or partial and generalized microdontia, depending on the number of teeth affected. The most common is partial, which occurs when microdontia is presented only in some specific parts. Typically, the most affected teeth are the upper incisors (most anterior teeth), one or both. In generalized microdontia, all teeth are smaller than normal, which can occur in pituitary dwarfism. A different problem is when the pieces are small in relation to the maxilla, due to their large size and, therefore, small teeth are evaluated (SILVA et al., 2016).

Dental anomalies occur between the sixth and eighth week of intrauterine life, as in this phase embryonic structures such as the dental sac, dental papilla and dental organ are converted, which in the histodifferentiation process will give rise to the formation of enamel, dentin and cement (LOBATO et al., 2019; OLIVEIRA; MIGUEL; MAGALHÃES, 2021).

Tapered teeth, as an expression of microdontia which is a dental anomaly, were described by Dr. Grahnén as those teeth in which the incisal mesiodistal width (incisal width) of the ring is smaller than the cervical width (the width of the area close to the gum line). It is an anomaly in the shape of the teeth, as they present an abnormal shape, and the affected tooth has a conical appearance. Conoid teeth have a prevalence of 0.6 to 9.9%. About 55 people are affected by cone-shaped upper lateral teeth, with women more prone than men (LOBATO et al., 2019; REIS et al., 2016).

The causes of dental anomalies, more specifically of conoid teeth, can be mainly associated with genetic factors such as dwarfism due to hypofunction of the pituitary gland. Small teeth in normal or large jaws may be due to cross-inheritance. Regression or atavism may be the cause of the rudimentary development of individual teeth, which take the cone or haplodon shape of the reptile or fish dentition. This abnormality is often inherited and occurs especially in the weaker teeth, the upper second incisors (SILVEIRA et al., 2015).

This anomaly can lead to lack of space, unfavoring the arch length, not only involving esthetics, but also impairing occlusion, since other teeth may adopt an incorrect position. Its etiology is related to hereditary, environmental, genetic and epigenetic factors. A possible method to diagnose microdontia of the upper lateral incisor when it is smaller, equal to or up to 0.7 mm wider than the lower lateral incisor, the result would be an excess of lower dental material in relation to the upper one (AGUIRRE et al., 2015).

Microdontia in any tooth can cause changes in the sagittal dimensions of the arch and these can be treated through restorative procedures to preserve esthetics and occlusion, taking into account a multidisciplinary diagnosis and treatment that includes evaluation by Periodontics, Orthodontics, Rehabilitation and Endodontics . Therefore, it is necessary to consider several factors, both aesthetic, functional, social and cultural (SILVA et al., 2016).

2.2 Treatment alternatives

According to Lima (2019), there are several treatment options for conoid teeth, ranging from less invasive, such as direct and indirect restorations, to more invasive, which correspond, for example, to extraction of conoid teeth and placement of an implant or a fixed prothesis.

2.2.1 Composite resin

Since their introduction in the 1960s, composite resins have become increasingly popular and are now considered universal materials, being the first choice for direct restorations on anterior and posterior teeth. The aesthetic characteristics of adaptation to the natural tooth color, ability to adhere to dental tissues, less need for complete tooth removal and the low cost compared to indirect materials are some of the reasons for the great popularity of composite resins (GUERRA et al., 2017).

It took some time for resin-based composites to be considered suitable materials for restoring anterior and posterior teeth. Poor wear resistance and mechanical strength were deficiencies of early generations of dental composites, at a time when silver amalgam was the gold standard material. Over time, advances in resin phase composition (eg monomers with higher molecular weight and lower polymerization shrinkage) and inorganic filler particles (eg higher loading, smaller size and distinct morphologies) have led to significant improvements in the properties of the resin. material. Current compounds also have greater color stability and better optical properties (BERWANGER et al., 2016).

Thus, the problems related to the selection of the proper composite resin is less of an issue nowadays. This does not mean that professional preferences and handling conditions, for example, are insignificant; rather, it indicates that the selection of restorative composites is currently not based on clinical performance, as the composite effect is only one of many aspects that influence clinical performance (LIMA, 2019).

Composite resins are a complex mixture of polymerizable resins mixed with inorganic filler particles. To bond the filler particles to the resin matrix, the particles are coated with silane, a bonding agent. Other additives are included in the formulation, such as photoinitiators, which initiate polymerization, adjust viscosity and improve radiographic opacity (MARTINS et al., 2017).

The resin matrix is composed of aliphatic or aromatic dimethacrylate monomers. These monomers (Bis-GMA - bisphenol-A-glycidyl methacrylate and triethylene glycol dimethacrylate - TEGDMA) play a fundamental role in the potential of polymerization shrinkage of resins. Usually used together, this system presents relatively satisfactory clinical results, but there are still properties that need to be improved, such as resistance to abrasion (PAMPULHA et al., 2015; SOARES; PINTO, 2019).

Filler particles provide dimensional stability to the resin matrix and improve its properties, reducing polymerization shrinkage, water sorption and thermal expansion coefficient, providing an increase in tensile, compression and abrasion resistance, increasing the modulus of elasticity (stiffness) of the composite resin (ARAÚJO et al., 2019).

During the initial development of composite resins, material properties were shown to depend on the formation of a strong bond between the inorganic filler and the organic matrix (resin). The union of these two phases is obtained by coating the charge particles with a binding agent, silane (NOBRE; GOMES, 2020).

Direct restorations in composite resins are indicated due to the great advances and increasing improvements in adhesive systems and composite resins. The main advantages of this type of rehabilitation are the easy repair procedure, easy execution, function and esthetic restoration, and the highly conservative character of this treatment, since little tooth structure is removed (DIAS et al., 2020).

Dias et al. (2020) also highlight that the silicone index helps to control the shape of the tooth in the execution of restorative treatment, which reduces the treatment time and determines anatomical dental contours that must be copied from the diagnostic wax-up.

The search for minimally invasive esthetic restorations has increased every day in dental clinics, and surgeons often have difficulties in choosing composite resins due to their lack of experience. For this choice, the dentist must evaluate each patient and the characteristics of each resin. In the same way as the physical characteristics of composite resins, the optical characteristics are of great relevance during a restorative procedure, such as color, translucency, opalescence and fluorescence, which are determining factors in the stratification and mimicry of the tooth structure (PAMPULHA et al., 2015 ; SOARES; PINTO, 2019).

Orthodontic treatment is used for conoid teeth as a previous auxiliary treatment (maintenance of the space to open or close space and adjustment of the midline and other occlusal characteristics when necessary) of any of the other treatments (resin and prosthesis) (PERASSO; IMELIO; ALCIDI , 2018).

2.2.2 Ceramic laminates

Ceramic veneers (LC), which are chosen to provide excellent esthetics, are a well-established treatment

method for the conservative esthetic restoration of malformed, discolored, misaligned, traumatized, fractured and worn anterior teeth. The recommended surface preparation within the enamel and adhesive cementation facilitate restoration with minimal loss of healthy tooth structure (ABRANTES et al., 2019).

Oliveira et al. (2021) present the following classification for indications for ceramic veneers:

Type I: teeth resistant to bleaching

◦ Type IA: tetracycline discoloration

◦ Type IB: teeth that do not respond to whitening

Type II: Main morphological changes

◦ Type IIA: conoid tooth

◦ Type IIB: Diastema or interdental triangles to be closed

◦ Type IIC: Increased incisal length or facial prominence

Type III: extensive restorations

◦ Type IIIA: Extensive coronary fracture

◦ Type IIIB: Extensive loss of enamel from erosion and wear

◦ Type IIIC: generalized congenital malformations.

Within this classification system, the use of LCs with minimal preparation and no preparation can conservatively achieve the desired aesthetic result for Types I and II. Initially, LCs were fabricated from stacked feldspathic porcelain and used in an “unprepared” manner 0.5–0.7 mm thick. While not removing healthy tooth structure was admirable, it often provided less-than-desirable results. The laminates often looked bulky and the soft tissue showed signs of irritation. It is important to remember that the ultimate goal of any dental treatment is to restore health and function, as well as esthetics, using the most conservative treatment method available (ESPÍNDOLA-CASTRO et al., 2020).

Many studies suggest a minimum thickness of 0.5 mm for dental preparations for CL. Freehand preparation can result in variable depth of preparation with dentin exposure. Ferrari et al. in 2005 they sectioned and measured the thickness of the labial enamel of 114 extracted incisor and premolar teeth at three locations, the gingival third, the middle third and the incisal third, with the results indicating that the enamel thickness in the gingival third was 0 0.3-0.4 mm for the incisor teeth. The authors argued that as enamel must be reduced by 0.5 mm in a veneer preparation, this would result in exposure of dentin at the gingival margin or, alternatively, if teeth were reduced less, an over-contoured restoration could result (GUGELMIN et al., 2020; OLIVEIRA JÚNIOR et al., 2019; TOMASELLI et al., 2019).

Inadequate lip reduction can potentially lead to increased varnish volume, whereas overreduction unnecessarily results in more extensive exposure of the dentin. In cases where the operator is not able to obtain a uniform reduction of the labial surface, taking into account the facial contours of the tooth, it is common to find areas of inadequate and unnecessarily extensive reduction within the same preparation. Given the tendency of insufficient preparation when teeth are prepared freehand, it is recommended to use an index drill or appropriate depth when teeth are prepared for LCs (OLIVEIRA JÚNIOR et al., 2019).

Patients with bruxism or tooth-to-foreign body contact may not be ideal candidates for veneers. In cases of minor incisal wear due to bruxism, it is often possible to restore the incisal length using LCs. It is very important to evaluate the occlusal scheme and control the occlusal forces before attempting any LC treatment. In these cases, an occlusal protection is indicated to help prevent postoperative ceramic fractures (ABRANTES et al., 2019; ESPÍNDOLA-CASTRO et al., 2020).

Abrantes et al. (2019) point out in their studies that because there is no need for much dental preparation before placing the veneers, the conoid tooth does not need to be further compacted or shrunk.

Given this, it is pointed out that the cost should be analyzed in principle due to the fact that the indirect veneers, whether they are resin, ceromeres or porcelain, are much more costly to the patient than the direct composite resin veneers. The price of resin or porcelain veneers is, for many patients, the decisive factor when choosing the best technique with a laminated dental veneer (ABRANTES et al., 2019; TOMASELLI et al., 2019).

The price of resin veneer is, in most dental services, lower than porcelain veneer. The reasons for the lower costs range from the reduced number of appointments – the treatment is carried out in a single appointment – to the dismissal of dental laboratories responsible for making ceramic laminates (ABRANTES et al., 2019; ESPÍNDOLA-CASTRO et al., 2020).

Other factors also contribute to further widening the price difference between resin and porcelain veneers. The main one, in the case of the porcelain technique, is the quality and experience of the dental laboratory. There are countless variations in composition and manufacturers, and they present different prices for each one of them – choices that directly imply the costs of these procedures (ABRANTES et al., 2019; TOMASELLI et al., 2019).

The success rate of LCs was clinically evaluated and showed a range from 18 months to 20 years; the success rate reported in these studies ranges between 75% and 100%. Fracture, microleakage and detachment are types of failure observed in LCs (ABRANTES et al., 2019).

The preparation of teeth greatly influences the durability and color (translucency and shade) of the ceramic restoration, as the dental preparation will determine the internal surface contour and thickness of the ceramic material. A laminate requires a minimum of 0.2 mm to (ideally) 0.3 mm thick for each shade change. Ceramic translucency also plays an important role in light penetration (TOMASELLI et al., 2019).

2.2.3 Dental prosthesis

In cases of severe microdontics, with extreme reduction in the dimensions of the teeth, more invasive prosthetic treatments are chosen, such as making fixed prostheses (unitary crowns) for those teeth. In case of teeth with reduced dimensions and little or no periodontal support (bone insertion), the clinician can opt for conoid tooth extraction and rehabilitation with removable dentures or dental implants (AGUIRRE; NOBORIKAWA; 2015).

III. METHODOLOGY

To carry out this work, a narrative literature review was carried out containing 17 articles that reference the treatment options for conoid teeth in the context general and specific to the proposed theme. Searches were performed in the Pubmed, Scielo and Google academic databases, for articles published between 2016 and 2021, using the keywords: “Microdontics”, “Aesthetic restorations”, “Conoid teeth”, “Compound resins”, “Ceramic laminates” or their respective terms in English.

IV. DISCUSSION

The smile is the most important segment in dentofacial cosmetic composition and the presence of dental anomalies in this segment can compromise its balance and harmony. Changes in the shape, size, position, color and texture of teeth have increased the demand for dental treatments, as they may set a pattern far from that established by the media and society today (LOBATO et al., 2019; REIS et al., 2016 ; SANTOS et al., 2015).

It is up to the dentist, after detailed anamnesis and correct diagnosis, to assess the patient's expectations and present possible therapeutic solutions, highlighting the best technique and the most appropriate material for each clinical situation (OLIVEIRA et al., 2020; SANTOS et al., 2015).

Isolated microdontics is a type of dental anomaly with greater prevalence in the upper lateral incisors. These teeth, called conoids, present a change in shape and size of the crown, giving the patient an atypical and childlike smile. The presence of anterosuperior diastemas associated with this morphological change and the reduction in the mesiodistal diameter of the lateral teeth, which allows tooth movement, are very common (LOBATO et al., 2019; OLIVEIRA; MIGUEL; MAGALHÃES, 2021).

In the initial approach, molding to prepare the model study, radiographs, as well as photographs from different angles so that the professional can observe and prepare the treatment plan are very important. For esthetic correction of the conoid tooth, the professional can use direct or indirect dental anatomization techniques. Indirect techniques, such as the manufacture of ceramic laminates or dental contact lenses, have advantages related to color stability, gloss stability and wear resistance. However, the need for dental preparation, the greater number of consultations, and the high cost may represent limitations of the technique (AGUIRRE et al., 2015; SILVA et al., 2016).

The current restorative dentistry advocates a minimum of invasive philosophy, where the professional should choose, whenever possible, procedures that preserve tissue and avoid the loss of healthy tooth structure. Due to technological advances in esthetic dentistry, current compounds are able to meet the esthetic requirements of inconspicuous restorations. Furthermore, the use of composite resins for esthetic corrections has advantages over other techniques, due to the possibility of reversibility, lower costs with the patient and less time in the chair (BERWANGER et al., 2016).

Among the types of resins available on the dental market, nanoparticulates have excellent mechanical properties compared to previous resins and excellent aesthetics. The presence of particles from 5 to 20 nanometers, representing 78% of the weight in the load, allows for greater surface smoothness and maintenance of gloss (GUERRA et al., 2019; PAMPULHA et al., 2015; SOARES; PINTO, 2019).

In a setting where failures due to inadequate selection of materials are minor, restorative technique and other clinical conditions may be of greater importance. Literature shows that tooth position (posterior teeth have to bear higher mechanical loads), use of a thick glass ionomer cavity lining layer, presence of endodontic treatment, absence of peripheral enamel approximately are all factors that can negatively affect clinical longevity. In contrast, frequently mentioned factors, such as enamel chamfering, use of rubber insulation, and use of direct versus indirect

composite, have not been shown to be related to clinical performance. In many situations, such as in the selection of the bonding system, a material-dependent effect also interferes with clinical performance (PEREIRA et al., 2017; GOUVEIA et al., 2018).

Impaired vision of malformed teeth, such as conoid laterals, can be successfully improved by porcelain or ceramic restorations. A precise and interdisciplinary diagnostic approach is advised to obtain aesthetic, conservative, predictable and lasting results in the maxillary anterior dentition (ABRANTES et al., 2019; GUGELMIN et al., 2020; TOMASELLI et al., 2019). In this sense, Silami et al. (2016), evidenced in their studies that diagnostic additive waxing, aesthetic elongation of the clinical crown, direct acrylic mock-up, cementation procedures, direct restorations with composite resin used for the aesthetic rehabilitation of a patient with conoid lateral incisors, and a unsatisfactory Class IV restorations in the central incisor were presented and, as an alternative, ceramic veneers, ensuring their practicality and duration, unlike other techniques already used in the study patient.

Corroborating the previous notes, Abrantes et al. (2019) mention that ceramic laminates are one of the most used cosmetic dentistry services in the market. Many dentists use laminates as a solution for certain forms of microdontia, especially conoid teeth. As much dental preparation is not required before placing the veneers, the already small tooth does not need to be further compacted or shrunk. Ceramic, a strong, high-quality material, helps make new teeth natural while making teeth more durable.

Gugelmin et al. (2020) and Oliveira et al. (2021) reinforce that porcelain materials have great biocompatibility and, at the same time, can maintain favorable dental esthetics and patient satisfaction. These studies, with evaluation times ranging from 5 to 20 years, support that therapy with ceramic veneers in conoid teeth has a favorable clinical performance.

Lobato et al. (2019) suggested that the success of the ceramic veneer technique on conoid teeth involves paying close attention to detail for the following: case planning, conservative preparation (to save enamel) of teeth, proper selection of ceramics, proper selection of materials and methods adequate cementation, finishing and polishing of restorations, and adequate planning for ongoing maintenance.

Cabral et al. (2016), in turn, treated a patient aged 22, due to a complaint of separation between the lateral and canine teeth on both sides, that is, involving dental elements 12, 13, 22 and 23. undergoing orthodontic treatment, it proved unsuccessful and, therefore, the woman sought care, in order to seek a solution. After removing the orthodontic appliance, scaling with an ultrasonic instrument and prophylaxis, it was possible to evaluate how the treatment would take place. Composite resins were used and increments were made to adjust the appropriate size. Afterwards, there was a finishing and polishing. The result was satisfactory, given the transformation of spaces for better adaptation in the arcade

In relation to an orthodontic treatment using ceramic veneers, one can cite the one carried out by Perasso, Imelio and Alcidi (2018), in which it was necessary to treat a 27-year-old woman with esthetic complaints regarding her smile and front teeth. Initially, in addition to other problems identified, there was a change in the shape of the upper lateral incisors and a small diastema between the central incisors. Therefore, the steps for therapeutic intervention were firstly to perform an orthodontic treatment, followed by whitening, analysis with the patient as to the lateral shape that the patient wanted and, finally, the reconstruction of the upper sides with ceramic veneers. As a result, a correct distribution of spaces between the upper lateral incisors was obtained, as well as their inclination, which resulted in a reduction in overbite. In addition, there was an improvement in lip support and the initially conoid teeth were restored, forming a good integration with the natural teeth. With that, the patient was satisfied.

V. CONCLUSION

Given the above, the following conclusions can be drawn:

- Conoid teeth are changes in size and shape of natural teeth. These changes have an aesthetic effect on the patient's smile, as the affected teeth are smaller than normal and have a sharpened incisal surface;

- The restorative technique using composite resins is an excellent alternative to re-anatomize conoid teeth when the treatment is planned and carried out in a detailed manner;

- Ceramic veneers are a well-established treatment method for the conservative esthetic restoration of malformed teeth, such as conoids, and when made according to proper indications and a precise clinical protocol, they offer excellent longevity and appearance. Not all patients can bear the costs of procedures with ceramic veneers, as they can be quite costly when the number of teeth involved is high.

- The minimally invasive cosmetic dentistry should choose the most conservative method possible, avoiding unnecessary wear and tear on the tooth structure.

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The representation of women in international organisms: a study on the protagonism of women in Angela Merkel and Dilma Rousseff foreign policy projects

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***Keywords*— International Relations. Feminism. Genre.**

***Abstract*—** *The sociological logic of the study of international relations is based on the recognition of asymmetrical power relations, based on their performance, as realism and neorealism arise from there, and this tradition coincides with the development of views in the study of gender and feminism. , where the epistemological principle is similarly asymmetrical relationships between men and women in their social, cultural, economic, political, etc. roles. Indeed, feminist approaches to International Relations have introduced gender as an essential tool for analyzing interactions between states in the international framework. However, despite these efforts to build a better International Relations Theory, feminist analysis has had little impact on international politics. The objective of this work is to analyze the role of women in international organizations from the agendas of female representation in the foreign policy projects of Angela Merkel and Dilma Rousseff. The analysis shows that feminist research has demonstrated the value of taking women's experiences and contributions seriously and used this as a basis to demonstrate how IR builds on and perpetuates gendered ideas about who does what, who experiences what - and why - in global politics. Furthermore, there is also recognition that women are important agents in political, economic and social processes. Despite its designation, feminism does more than focus on women, or what are considered women's issues, by highlighting inequality and power relations, feminism reveals the power of gender and what it does in global politics. Concerned with the subordination of women to men, gender inequality and the construction of gender identities, feminism challenged a homogeneous concept of 'women' in IR and exposed gender logics as powerful organizational structures. It is concluded that transcending this debate that we have exposed is more than a political academic in nature, it is the first step to propose a relationship between the two disciplines that allows us to give a new meaning to the analysis of the international situation, and for that, it is necessary leaving behind the theoretical analytical debates, and moving on to selecting, designing or adapting practical methodologies that can be formalized and standardized to achieve the goal of the gradation.*

I. INTRODUCTION

Until recently, women were excluded from diplomatic service and international relations on the grounds that they would not be taken seriously by foreign governments and would create insurmountable administrative difficulties, especially in relation to their marital status.

Today, women in leadership positions are still an unpopular concept in many parts of the world, but countries are increasingly inclined to embrace trends in modern diplomacy where men and women are represented equally on the basis of merit and position. The state of international affairs must reflect an entire society, rather than limiting it to the status and opinions of men.

The 21st century is the century of social, political and economic empowerment of women around the world, and this will manifest itself in international relations. The exclusion of women's views and perspectives from foreign policy will gradually become more unacceptable, and the movement initiated by Foreign Minister Wallström will spread across the globe in this century because of its morality and pragmatism.

Gender diversity is important for several reasons. First, a more diverse workforce means that the international relations industry better reflects society as a whole. Second, it expands the population coverage of the industry and therefore increases its talent pool. Third, gender balance in a workforce has other very noticeable benefits: it yields a broader range of ideas and experiences, leads to greater productivity, more innovation and better decision-making, and provides a more positive and healthy (ENLOE, 2017).

The sociological logic of the study of international relations is based on the recognition of asymmetrical power relations, from its performance, as realism and the theories of neorealism arise from there, and this tradition coincides with the development of views on the study of gender and the feminism, where epistemological principles are equally asymmetrical relations between men and women in their social, cultural, economic, political roles, etc., and it is from this recognition of inequalities that we can locate the philosophical point of union between feminist theories and international relations.

This argument may seem very strange for the beginning of a process of theoretical reflection, however, the idea is very simple, both theories, international relations are part of the academic status with greater emphasis on a more pragmatic logic, understanding the debate more in terms of diplomatic processes than developing a theoretical-methodological that generates a sense of science and, in the same way, gender theories or the feminist debate were reduced to a marginal field of discussion in the field of social sciences, since it reduces to a very closed and very focused academic group.

However, it must be said that the potential of gender analysis and feminist approaches would be of great use in the scientific and academic analysis of different areas, and especially in the field of international relations, so far, the fundamental contributions of feminism although welcome from different criticisms have been virtually ignored by the mainstream or conventional core of international relations studies.

The growth of feminist movements within political and social theory has produced analyzes with clear implications for International Relations Theory. This includes discussions of gender-specific definitions of security, power, authority and others. Feminist argued that the theoretical foundations of International Relations are based on traditional dichotomies between men and women.

The inclusion of women at all levels of international relations will spread as a far-reaching, efficient and representative element of our modern societies. In that way, we will be highly equipped to serve the national interests of security and prosperity – the essence of foreign policy objectives. Post-conflict reconstruction is one of many areas that will benefit from this inclusion, enabling world leaders to address current gaps in the transitions from conflict to stability. These include the lack of involvement of victims (mainly women) and the lack of trust caused by the absence of women.

Women have been calling for more gender equality for more than a century. By putting more women in politics and ensuring that all of society is represented at all levels of decision-making, we will move faster towards equality, inclusive development and peace.

Given this, the following issue arises: What are the effects of female representation in international organizations from the activism of the foreign policies of Angela Merkel and Dilma Rousseff?

The aim of this paper is to analyze the role of women in international organizations from the agendas of female representation in the foreign policy projects of Angela Merkel and Dilma Rousseff. The specific objectives are: To characterize the actions that constitute female political activism in international organizations; Analyze whether there has been a change in female representation in international organizations; Analyze the Brazilian and German programs for the inclusion of women in diplomacy.

For a long time, women were seen as victims - of discrimination and illiteracy, of violence, and confined to

positions of deference in society because of once unbroken cultural and religious traditions.

But as democracy advances, women are becoming a growing force on the world stage. We are seeing a new voice of activism emerge that speaks for freedom and the advancement of civil liberties and human rights.

This movement seeks to dismantle repressive regimes in Asia and the Middle East, while working to build more just, progressive and prosperous nations. This revolution is taking place all over the world – from Asia and the Middle East to America.

Despite the strident clamor for democracy, the role of women in democratization is dramatically less clear and powerful than it should be. Unfortunately, this is precisely when their voices are needed most.

The global shift towards democracy is more than a feminist movement calling for women's rights and gender equality above and beyond democratic progress. Instead, women in states across Asia, the Middle East and elsewhere are demanding the rule of law, strong institutions, social justice and economic opportunity for all citizens – not just women. Critically, they defend the broader cause of democratization, freedom and autonomy.

In recent years there have been several political and social changes, especially considering South Korea's first woman president, the public condemnation of rape in India and the "democratic constitution" of Egypt.

Some observers might assume that states, which once treated women as second-class citizens, are becoming fairer. Perhaps women are being treated more equally before the law, gaining more respect in society and gaining greater power to shape political, economic and social change.

Women in government, including prominent examples such as Hillary Clinton, Christine Lagarde, Angela Merkel, Michelle Bachelet of Chile and Dilma Rousseff, accelerate the modern women's movement. In 2010, the United Nations took the historic step of defending women's rights when the General Assembly created the United Nations Entity for Gender Equality and the Empowerment of Women, better known as UN Women.

Women's empowerment is a pervasive theme in policy discussions in government and civil society around the world. Today, thousands of nonprofit organizations support women's educational, reproductive, political, and economic rights and opportunities. Policy makers must understand that the role of women in democratic reform is a central element of development and stability.

Being a little more exact, with a view to considering gender studies in International Relations, the literature shows a great advance in the last decades. The contributions are diverse, ranging from the insertion of feminism in the debate on international security to the contribution of gender International Relations. However, studies of this nature are still incipient in Brazil and, therefore, one of the main reasons for carrying out this study, which serves as a source for new debates between the academics of the course and society in general.

The methodology adopted was, first, the bibliographical research. It was an exploratory research that was carried out with the intention of going deeper into issues related to the representation of women in international organizations. Regarding the treatment of data, we opted for the analysis of content available on the Internet, such as interviews and speeches by Dilma Roussef and Angela Merkel and document analysis, as we believe they are suitable methods when the phenomenon under observation is to analyze the role of women in organisms. from the agendas of female representation in foreign policy projects.

II. LITERATURE REVIEW

Feminist perspectives in international relations (IR) seek to understand existing gender relations - the dominance of masculinities over femininities - in order to transform the way they function at all levels of global social, economic and political life. Within International Relations, feminist theorists drew on the experiences of marginalized and oppressed peoples, including women, in order to challenge and revise the epistemological and ontological foundations of the field. They interrogated the gender bias inherent in rationalist forms of knowledge and embedded in the core concepts and concerns of International Relations, such as states, sovereignty, power, security, international conflict and global governance. More recently, feminists have given an explicit explanation of their alternative methodologies for researching international relations.

International relations feminists share a praxis-oriented normative theory, consciously building theory out of practice and to guide political practice, but their normative theoretical and political positions are plural. They differ in the philosophical foundations of their knowledge of the international reality of gender, the theoretical location and centrality of gender as an analytical category in the study of international relations, and, on this basis, its prescriptions for ethical conduct. Here, the similarities and differences between feminist theories of international relations are explored.

2.1 Historical approach

Feminist theories of international relations have developed along with some impressive shifts and significant power shifts in contemporary international relations. Like all feminist scholarship, Feminist International Relations is indebted to and closely related to the second wave feminist movements that flourished around the world in the 1960s and 1970s. These movements were the harbingers of feminist theories that analyzed sex and gender. as social constructions to be transformed rather than facts of nature to be taken for granted. Feminist theory itself was seen as an essential form of feminist practice that could challenge the male dominance of academic knowledge. Feminist scholars shaped by their activist experiences have seen it as a moral imperative to include women's voices and change both the subjects and objects of study. Many feminist theorists attribute their interest in international relations as an area of study to their involvement in Cold War peace movements and feminist peace politics dating back to World War I and efforts to broker international peace and security in the League of Nations. (TICKNER, 2006).

Not surprisingly, in the late 1980s, the first feminist contributions to the IR field were highly politicized and controversial, as the field was, at the time, one of the most male-dominated and centered on interstate diplomacy and war, in the face of dealing with almost exclusively male matters. Feminist scholars have used gender analysis to deconstruct the theoretical framework of International Relations and reveal the male bias that permeates key concepts such as power, security and sovereignty (TRUE, 2009).

They argued that these concepts were specifically identified with masculinity and men's experiences and knowledge derived from an exclusive and male-dominated public sphere. For example, Tickner (2006) explored the realist concept of power through his analysis of Hans Morgenthau's six principles of power politics, showing how it is based on male norms of rational and autonomous agency. Likewise, Sylvester (1992) has argued that the assumption of self-help as the essential feature of world politics masks the many "international relations" in other institutions, including families, trade regimes and diplomacy. In turn, Enloe (1996) argued that studying the activities of women in world politics, those marginalized and/or excluded from the official accounts of international relations, exposed how much "power" is needed to keep the international political system centered on the state.

Paying attention to the experiences of women and men in peace and war, feminist scholars such as Enloe and Tickner insisted that international security must be redefined. In her book Gender in International Relations, Tickner noted in particular that what is called "national security" is profoundly threatening human survival and sustainable communities and does not take into account women's experiences of insecurity (TICKNER 1992).

Two decades later, several leading disciplinary journals have published entire issues on the issues of women, gender and feminism in international relations, and in 1999, the International Feminist Journal of Politics was established to promote dialogue among scholars of feminism, politics and international relations. The sudden collapse of communism and with it the bipolar international system that seemed so intransigent had far-reaching implications for the IR field as a whole and for IR feminism in particular. The dominant realist theories of international relations, singularly focused on power politics between states and to a large extent on the Cold War between the two superpowers, did not foresee this transformation. Nor could they explain it. Failing to look beyond elites and the systemic level, the main flaws of realistic explanations have been exposed (TRUE, 2009).

The end of the Cold War also had a profound impact on the political opportunities available for principled non-state actors to participate in global politics and include non-traditional issues on global political agendas. As feminist perspectives began to challenge IR norms, women's movements gained a foothold at the United Nations and began to use this international institution to mobilize global alliances of Western and non-Western women activists, academics and policymakers (ANTROBUS, 2005; HARCOURT, 2006).

An epistemic feminist network that included International Relations feminists emerged through the UN and other international conferences in the 1990s. The 1990s also ushered in two successful global campaigns for women's rights to be recognized as rights. in international law and to address a range of egregious practices, often state- and culturally sanctioned, as forms of "violence against women" (Weldon, 2006). Transnational feminist networks have used their substantive expertise in gender relations – both through critical argumentation and evidence-based research – to engage institutional power (TRUE; MINTROM, 2013).

By the end of the millennium, it seemed that feminists were more successful in engaging international institutions than in influencing the discipline of IR. Anti-war feminists helped the United Nations Security Council pass Resolution 1325 guaranteeing women's rights to participate in international peace negotiations and operations, while feminists criticized neoliberal globalization and the disproportionate impact of structural

adjustment policies on women. poor women have made significant inroads at the World Bank and other international development agencies. At the same time, the European Union formally adopted gender mainstreaming as a methodology to pay attention to gender inequalities and differences in all policy domains and areas of competence.

Feminist perspectives in international relations mirrored the focus of global women's movements, rather than the statist theoretical concerns of the dominant field of International Relations, developing gender analyzes of nationalism and ethnic conflict, democratization and economic globalization. Tickner (2006) noted that major American international relations, in particular, were narrowly focused on their own paradigmatic research questions, marginalizing the most popular issues that dominated the global public sphere in the 1990s. She and other international relations feminists lamented the lack of engagement of the mainstream of International Relations with feminist theories, but they noted the intellectual gap between their different epistemological approaches.

While the post-Cold War era allowed many political opportunities for feminists and other critical IR perspectives to shape the IR research agenda, the events of September 11, 2001 changed this relatively conducive environment for innovative and radical approaches to international relations. Tickner (2006) observed that feminist International Relations in the 1990s was mainly dedicated in one way or another to the analysis of the international political economy, in particular the gender dimensions and the effects of economic globalization. But like other International Relations theories responding to the changed global political context, the emphasis of feminist analysis shifted after 9/11 to focus more on international security. Unlike other IR theories, however, feminist analyzes have sought to understand the gendered roots of terrorism in underlying political and economic inequalities and in the constructions of masculinity in Western and non-Western contexts that contribute to global insecurities (KAUFMAN-OSBORN, 2005).

2.2 Philosophical, anthropological and sociological approach

The literature on gender covers a wide field and consists of contributions from many disciplines with a variety of interests and methodologies. The emphasis is on the complexity of the concept. Hopper (2001) points out that there is no consensus on the nature or meaning of gender identities, how they are produced or whether they should be reinforced, modified or abolished, even among feminists, who by no means have a monopoly on gender theory.

Despite the divergences on the specifics of the concept, an attempt is made to explain what the term gender generally means and how it relates to the study of international relations. As mentioned by Tickner and Sjoberg (2007), feminists propose that gender is a set of socially constructed characteristics that describe what men and women should be, as opposed to sex, which is biologically determined. It is said to have a cultural form and vary over time and place. Young (2004) says that the concept of gender keeps in the foreground the relational nature of the masculine and feminine categorizations, and indicates the importance of not taking it as a given or necessarily natural. Ann Oakley (1972) propagated the analytical distinction between biological sex and socially constructed gender that is essential to the study of gender. Beauvoir (2001) recognizes the diversity of opinions surrounding the concept of gender and proposes that gender theory revolves (or should) revolve around three dimensions of analysis: first, physical incorporation, including the body and the role of biology reproductive. then, gender institutions and social processes that encompass, including the family, the economy, the state. And, finally, the discursive dimension of the gender construction of language and its constitutive role in the gender order.

According to Sheperd (2010), conventional IR theories do not consider the individual, but focus on the interaction between states. Classical realism, for example, makes assumptions about human nature by referring to the nature of man; this is related to the essentialist understanding of the body as natural as opposed to social or political. Enloe (2004) considers the problems of incorporating gender into political discourse, stating that many people do not take gender seriously. She says the general attitude is to dismiss this as irrelevant, and concludes that the difficulty many IR scholars have in taking feminist analysis seriously may be due to their being male, and would have to consider carefully when and how their own relations with the masculinity are affecting what they have chosen to consider a serious topic of investigation. Tickner (1992) notes that the central concern of realism, the dominant paradigm in international relations since 1945, has been with issues of war and national security in the post-World War II international system.

For Young (2004), the emphasis of realism is on power, autonomy and rationality; it is closely linked to traditionally masculine characteristics. Thus, in Colgan's terms (2017), these assumptions, in turn, shape the global policy process and the impacts they have on the lives of men and women. Rather than suggesting that traditional IR was gender neutral – that is, that gender and IR were two separate spheres that had no impact on each other –

feminist theory has shown that traditional IR is, in fact, blind to the gender problem.

From the beginning, feminist theory challenged the almost complete absence of women from traditional IR theory and practice. This absence is visible both in the marginalization of women from decision-making and in the assumption that the reality of women's daily lives is not affected or important to international relations. Furthermore, feminist contributions to IR can also be understood through their deconstruction of gender – both as socially constructed identities and as a powerful organizational logic. This means recognizing and then challenging the assumptions about male and female gender roles that dictate what women and men should or can do in global politics and what matters in IR considerations.

As Tickner (2008) highlights, feminists have divergent approaches to the study of gender that relate to different goals. The goal of liberal feminists, for example, is to eliminate legal obstacles to overcoming women's subordination. Marxist and socialist feminists seek explanations for women's subordination in the labor market, which offers greater rewards and prestige for paid work in the public sphere than for unpaid domestic work. Furthermore, postcolonial (decolonial) and poststructuralist understandings of feminism assert that one cannot generalize about women because they may have different experiences of subordination when we bring up other categories of analysis such as race, class and gender. However, feminism embraces the idea that international politics has been a male-dominated discipline and that this has resulted from a combination of social processes and structures that have been created and sustained over generations, sometimes in a coercive way.

Feminist studies therefore takes women and the gender issue seriously and, in so doing, challenges the canonical assumptions and concepts of IR.

What is common among the work of feminists in International Relations is, on the one hand, using gender as a category of analysis in conducting their investigations, and, on the other, the centrality they give to methodological issues, which can be an explanatory reason for the marginality of feminism in the discipline, as the field tends to judge researchers in terms of how well they operationalize and test existing theories rather than valuing the theoretical and methodological innovations they present (TICKNER, 2005, p. 217).

If we start with the first contributions of feminism – making women visible – one of the first contributions of feminist theorists is revealing that women have been and are routinely exposed to gender-based violence. By making violence against women visible, an international system that has tacitly accepted a great deal of violence against women as a normal situation has also been exposed.

Mendes (2011) and Mendonça (2015) point out that traditional perspectives that ignore gender not only neglect the contributions of women and the impact that global politics has on them, but also perpetually justify this exclusion. If women are outside these realms of power, their experiences and contributions are not relevant. Feminist theorists have worked to demonstrate that this distinction between private and public is false. In doing so, they show that previously excluded areas are central to the functioning of IR, even if they are not recognised, and that the exclusion and inclusion of certain areas in traditional IR thinking is based on gender ideas about what counts. and what doesn't count.

According to Matuella (2017), these socially and politically produced gender identities shape and influence global interactions, and IR as theory – and global politics as practice – also produce these gender identities by perpetuating assumptions about who should do what. what and why. These gender identities are also empowered, in particular patriarchal power, which subordinates women and female gender identities to men and male gender identities. What this means is that socially constructed gender identities also determine power distributions, which impact where women are in global politics. Considering that men can be feminine and women masculine, masculinity is expected for men and femininity for women.

2.3 Specialized approach in International Relations

Enloe (2017) asked the question: where are the women? Encouraging IR scholars to see the spaces that women occupy in global politics and demonstrating that women are essential actors in the international system. She focused on deconstructing the distinctions between what is considered international and what is considered personal, showing how global politics impacts and is shaped by the daily activities of men and women, and, in turn, how these activities are based on identities. of gender.

Traditionally, militarism and warfare have been seen as masculine endeavors, linked to the idea that men are warriors and protectors, that they are legitimate armed actors who fight to protect those who need protection – women, children and men who do not fight. In practice, this means that the many ways in which women contribute to conflict and experience conflict were considered peripheral, outside the scope of IR considerations. For example, according to Matuella (2017), the issue of sexual and gender violence in conflicts only recently entered the international agenda.

By comparison, the mass rape of women during and after World War II was not prosecuted, as the occurrence was considered an unfortunate by-product of the war or simply ignored. That has since changed, with the 2002 Rome Statute recognizing rape as a war crime. However, this recognition has not led to a reduction in conflict-related sexual violence and this form of violence remains endemic in many conflicts around the world, as does impunity for its occurrence outside the realm of IR considerations.

These questions highlight the importance of intersectionality – the understanding that IR is shaped not just by gender, but also by other identities such as class, race or ethnicity. Intersectionality refers to where these identities intersect and, in turn, how different groups of people are marginalized, suggesting that we should consider each together rather than in isolation. When examining rape during war, Bastick (2017) showed the intersection of gender and ethnic identities, where the enemy's women are constructed as others and violence against them, consequently, comes to represent the expansion of ethnic territory by the male conqueror. . This relies on constructions of gender, which occur at the intersections with other forms of identity, such as ethnicity or race. Gender constructions that see women characterized as protected mean that conquering them – through rape or sexual violence – is representative of power and domination over the enemy. Applying feminist theory to the issue of male rape during war also shows the gender logic that informs its occurrence, in particular that the rape of male opponents is seen as a way of feminizing (ie humiliating, defeating) opponents. This again highlights the contribution of feminism in understanding how gender influences IR and how the female is underestimated or undervalued.

As discussed above, Ventura and Kritsch (2016) show that feminism has exposed gender violence and the marginalization of women in global politics. However, it also challenges women's gender constructions as inherently peaceful, in need of protection or as victims. Feminists see these constructions as further evidence of gender inequality and also as a contribution to the exclusion of women from traditional IR perspectives in the first instance. If women are seen as victims rather than actors or as peaceful rather than aggressive or as existing only in the domestic or private sphere (rather than the public sphere), then their experiences and perspectives in global politics are more easily ignored and justified as marginal . Accounts of women who broke these gender identities, as agents of political violence, for example, challenged these assumptions. This is an important contribution of feminism and one that challenges the construction of gender identities that do not reflect the diversity of women's commitments to IR and, in practice, perpetuate women's limited access to power. Therefore, taking feminism seriously is not only about overturning the historical marginalization of women, it also provides a more complete picture of global politics, taking into account a broader range of actors and actions.

The inclusion of gender as an IR methodological and pedagogical source has been discussed for some decades. Particularly in IR, some authors have engaged in the debate about possible ways to teach gender in this discipline. Souza (2014) explored four approaches to doing this: 1) not seeing evil, not reading evil, not teaching evil, where gender is irrelevant; 2) add and incorporate women, not gender, into the IR debate, exploring only a few selected issues related to feminist theory, where appropriate; 3) multiple paradigms, which recognizes the multiplicity of possible approaches to IR considering the interrelationship between them and, therefore, recognizing different forms of feminism and varied approaches to gender in the discipline; 4) Gender IR, in which concepts such as politics, power, autonomy and cooperation are redefined to reflect gender relations, which are intrinsic to criteria such as race, religion, social class and geographic location; This involves enormous analytical complexity, requiring that RI methods and resources be rethought.

In a similar vein, Mertus (2007) identified three variants of feminism in IR. A first approach, which she calls equality feminism, seeks to identify situations in which women are invisible in IR, except when playing typically male roles. Similar to Souza's (2014) approach to adding and incorporating women, this emphasis argues that including more women in all areas of representation would be sufficient to satisfy the demands of feminism. The second approach, on the other hand, recognizes the existence of gender asymmetries at the very base of the international political system, as the definition of problems and groups relevant to IR reflects male interests at the expense of female ones. Finally, the third approach recognizes epistemological problems at the root of knowledge generated in IR, which adopts a typically top-down perspective with a focus on state, sovereignty and power and neglects bottom-up analyzes of individuals, social movements and groups, and human relationships, therefore generally ignoring or obscuring female subordination.

In this way, it is understood that feminist reformulations of the definition of security are necessary to draw attention to the extent to which gender hierarchies themselves are a source of domination and, therefore, an obstacle to a truly comprehensive definition of security.

Feminist research has demonstrated the value of taking women's experiences and contributions seriously and used this as a basis to demonstrate how IR builds on and perpetuates gendered ideas about who does what, who experiences what - and why - in global policy. Furthermore, there is also recognition that women are important agents in political, economic and social processes. Despite its designation, feminism does more than focus on women, or what are considered women's issues. By highlighting inequality and power relations, feminism reveals gender power and what it does in global politics. Concerned with the subordination of women to men, gender inequality and the construction of gender identities, feminism challenged a homogeneous concept of 'women' in IR and exposed gender logics as powerful organizational structures.

Given the above, this chapter sought to show the normative commitments that infuse not only feminist issues, interpretations and claims to know international relations, but also how feminists do their work. There are many differences and variations among International Relations feminisms, but ethical commitments to inclusiveness and self-reflexivity and attention to relationships and power in relationships distinguish most feminist theories of international relations. These norms implicitly guide feminists to put into practice their own critical theories, epistemologies, and explicit normative commitments. Thus, rather than a source of division, contestations between International Relations feminisms about the epistemological foundations of feminist knowledge, gender ontology and the appropriate ethical stance in a globalized, albeit grossly unequal world, are a source of their strength.

III. METHODOLOGY

For the development of the present work, a methodological procedure was adopted referring to the path followed by the author to reach the general and specific objectives. In this section, the procedures and instruments used in carrying out the research will be explained.

According to Rea and Parker (2012, p.138) “Method is a regular, explicit and repeatable procedure to achieve something, whether material or conceptual”.

Thus, it is understood that the primary characteristic of the method is the objective, didactic and organized investigation, with a meticulous control of the information obtained together with the theoretical contributions.

The applicability of this work is classified as basic, generating as a result the amount of representation that women obtained during the period from 2010 to 2020 as participants in international organizations, in particular, Dilma Rousseff and Angela Merkel. In this way, it is highlighted that basic applicability research has great relevance through the generation of knowledge that, in different ways, can be applied to society (NASCIMENTO, 2018).

The approach is characterized as qualitative due to its relationship with the social sciences when it is concerned with presenting themes that will enrich the discussion of international relations with emphasis on the role of international organizations, gender equality and public policies, being a dependent subjective research the researcher's interpretation (GIL, 2012).

Regarding the objectives, this research is characterized as explanatory, as it shows women's protagonism in international organizations from the agendas of female representation in the foreign policy projects of Angela Merkel and Dilma Rousseff and which factors prevent them from acting as necessary , resembling Vergara's (2010, p. 8) idea of explanatory research “research whose main objective is to make it intelligible, is to justify the reason for some. Therefore, it aims to clarify which factors contribute, in some way, to the occurrence of a certain phenomenon”.

As for the procedures, this research is identified as bibliographical, being carried out from materials already published and made available. It is noteworthy that documents resulting from the United Nations conferences, documents provided by the Brazilian and German government and legislation will be analyzed, as well as books and scientific articles focused on the topic proposed herein.

According to Nascimento (2018, p. 65), “the bibliographic research constitutes a secondary source. It is the one that seeks to survey books and magazines of relevant interest for the research that will be carried out”. Also according to the author, its "objective is to place the author of the new research in front of information on the subject of interest". Thus, it is understood that it is a decisive step in any scientific research, as it aims to eliminate the possibility of carrying out a work in vain, spending time with what has already been shown.

For data collection, it used the method of document analysis, through reports provided by international organizations such as the United Nations (UN), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations International Emergency Fund for Children (UNICEF), International Labor Organization (ILO), United Nations Development Program, Organization for Cooperation and Development,

World Economic Forum, World Health Organization, Office of United Nations.

Some of the main data were made available about the United Nations Conference on Sustainable Development, Munich Conference, UN Climate Conference, at the United Nations Security Council, at the G20 Leaders Summit meetings, reports from the National Confederation of Industry (CNI) and the Federation of German Industries (BDI, its acronym in German) on priorities to facilitate trade between Brazil and Germany legal security, trade agreements, internet security that guarantees greater privacy on the internet after accusations that international leaders, like Dilma and Merkel, they had been the target of US government espionage.

Also analyzed were UN documents on the World Women's Conferences in which Dilma Rousseff and Angela Merkel participated and reports from the scope of International Security.

As the research progresses, a second stage will be to explore, through debates and international meetings transcribed on the internet and in the news, the relationship between Dilma Rousseff and Angela Merkel as the agenda of the aforementioned international organizations and how they contributed to an entity of the United Nations for Gender Equality and the Empowerment of Women, the "UN Women".

According to Nascimento (2018, p. 56), data collection for research is the "process of collecting data for secondary use through specific techniques". The author goes on to state that "these data are used for research, planning, study, development and experimentation tasks". Thus, for the results to be satisfactory, it is essential to plan for the implementation of the data collection methodology.

IV. RESULTS AND DISCUSSION

4.1 Actions that constituted female political activism in international organizations

For a long time, women were seen as victims - of discrimination and illiteracy, of violence, and confined to positions of deference in society because of once unbroken cultural and religious traditions. However, as democracy evolves across the globe, women are becoming a growing force on the world stage. We are seeing a new voice of activism emerge, speaking in defense of freedom and advancing civil liberties and human rights.

This movement seeks to dismantle repressive regimes while working to build more just, progressive and prosperous nations. This revolution is taking place all over the world - from Asia and the Middle East to America. Despite the clamor for democracy, the role of women in democratization is less clear and powerful than it should be. Unfortunately, this is precisely when their voices are needed most.

The global shift towards democracy is more than a feminist movement calling for women's rights and gender equality above and beyond democratic progress. Instead, women are demanding the rule of law, strong institutions, social justice and economic opportunity for all citizens – not just women. Critically, they defend the broader cause of democratization, freedom and autonomy.

Angela Merkel has made more than 80 government statements during her 16-year tenure. In her first address to the German Parliament, on November 30, 2005, she spoke of what it was like to be the first woman to hold the position of the country's federal chancellor. "Who would have thought that the highest office in government would be given to a woman already this year? Who would have thought, ladies and gentlemen?" she questioned.

In a Speech by Dilma Rousseff at the LXVI Ordinary Session of the UN General Assembly (New York, September 2011), the representation of the international context is highlighted. The statement would reflect on the international context the importance given to the world economic crisis as an element of conditioning the action of States. Therefore, in the words of the then president, "The world is facing a crisis that is, at the same time, economic, of governance and of political coordination" (Rousseff, 2011). Added to this, in a new passage, she declares that "We are facing an economic crisis that, if not resolved, could turn into a serious political and social rupture. An unprecedented rupture, capable of causing serious imbalances in the coexistence between people and nations" (idem).

To support the achievement of substantive equality, economic and social policies must work in unison. In general, it is considered that the function of economic policies is to promote economic growth and that social policies, in turn, seek to correct the failures of this growth; in other words, fighting poverty and reducing inequality. However, macroeconomic policies can aim to achieve a broader set of goals, including gender equality and social justice. On the other hand, well-designed social policies can boost macroeconomic growth and post-crisis recovery through redistributive measures that increase employment, productivity and aggregate demand.

Ultimately, the objective is to create a virtuous circle through the generation of decent work and social services and social protection mechanisms with a gender perspective, together with favorable macroeconomic policies that prioritize investment in people and the achievement of social objectives. Transforming economies

and realizing women's economic and social rights require action in the three priority areas described below: decent work for women, gender-sensitive social policies, and rights-based macroeconomic policies.

In the first section of her speech, the president tried to highlight the historic moment that the General Assembly was experiencing due to the fact that the debate was inaugurated by a woman. Thus, she somehow addresses gender issues through the statement “For the first time in the history of the United Nations, a female voice opens the General Debate. She is the voice of democracy and equality expanding from this rostrum, which is committed to being the most representative in the world.” (ROUSSEF, 2011).

Undoubtedly, IR is a male sphere, not only in its constitution, but in the way it addresses issues that concern it. Feminist scholars such as Tickner (2011) recognize the masculinity of strategic discourse, which is related to the hegemonic masculinity of states. State security is perceived as a fundamental value by citizens. National security and the maintenance of their interests remains an almost exclusively male domain.

Thus, the male construction of IR is also evident in the discourse used to justify the need to prioritize State security in its relations with other States. Not to mention that, as the author points out, it is not surprising that feminist International Relations remains largely outside conventional International Relations, because the concerns of the former, gender and women, continue to appear to be subsidiary to high politics and diplomacy.

In this way, IR actors prioritize issues related to masculinity before gender or femininity, either as an approach or in practice. Feminists, on the other hand, ask questions that are different from traditional IR theorists, now that they build their knowledge of international relations not so much from the perspective of 'insiders' but from the voices of disempowered and marginalized people not previously heard.

The sounds of these unfamiliar voices and the questions they raise sometimes lead conventional scholars to question whether feminists belong to the same discipline. So on, such arguments are used to dismiss gender analysis and highlight the reluctance of IR leaders to embrace it.

Already in the speech of the XVII Ordinary Session of the UN General Assembly (New York, September 2012). Dilma Rousseff begins her speech dealing with gender issues as she did the previous year. In the voice of the statesman "Once again a female voice opens the debate at the United Nations General Assembly." The statement will also delegate a singular importance to the South American region. According to this concept, the president states that “Our region is a good example for the world. The rule of law that we achieved by overcoming the authoritarian regimes that marked our continent is being preserved and is being strengthened.” (ROUSSEF, 2012) In addition, she adds, "For us, democracy is not a heritage immune to assault, we have been firm, - Mercosur and Unasur - when necessary, to avoid setbacks because we consider integration and democracy inseparable principles." (idem).

Indeed, the masculinity of IR is perceptible in the mere way it defines femininity, masculinity and the issues associated with them. Meanwhile, “feminists define gender, in the symbolic sense, as a set of variable but socially and culturally constructed characteristics - such as power, autonomy, rationality and public - that are stereotyped, associated with masculinity. Its opposites - weakness, dependency, emotion and privacy - are associated with femininity. It is in this sense that men and women are related to different roles within IR: security is to men what domesticity is to women.

Thus, in the IR sphere, while men are associated with defending the state, interpreted as the highest form of patriotism, women are excluded from this, instead engaged in the domestic sphere in 'organizing' and comforting roles as mothers. or providers of basic needs and care professions such as teachers and nurses. This broadly portrays what it means to be a man or woman in international politics and what is expected of a person according to their gender. It is then that women and their association with the private sphere of domesticity, morality, subjectivity and passion represent everything that the IR field is not, especially in terms of its disciplinary boundaries. These restrictions shape the assumption that women belong to a private domain and have no place in IR because it is speculated that they are inherently contrary to the nature of the domain. However, it should be noted that this is the only way for gender to be considered in IR: as a coercive tool.

German Federal Chancellor Angela Merkel told the 2019 United Nations Climate Conference that "there is no doubt" that global warming is caused by humans and that the international community needs to act together to contain the climate crisis . "We have only one Earth," said the chancellor in New York. "That's why we, as representatives of industrialized countries, have a duty to use innovation, technology and money to build a path to stop global warming."

The United Nations Environment Program is the world's leading environmental authority. It sets the environmental agenda at the global level, promotes the coherent implementation of the environmental dimension

of sustainable development in the United Nations system, and acts as a strong advocate for the environment. The mission is to lead and encourage joint work in caring for the environment, inspiring, informing and enabling nations and peoples to improve their quality of life without compromising that of future generations.

In September 2020, German Chancellor Angela Merkel criticized the UN Security Council's blockade in the face of several of the main current conflicts and demanded reforms, making clear Germany's willingness to occupy a seat in this body. "Germany is ready to continue to assume responsibility," Merkel said in a video message on the occasion of the organization's 75th anniversary celebration.

It is important to note that Berlin has been calling for years, together with Brazil, that the Security Council be expanded with new permanent members, a status that is currently only granted to the USA, China, Russia, France and the United Kingdom, since the victory of the allies in World War II.

4.2 Changes in female representation in international organizations

By making women visible, feminism also highlighted the absence of women in institutional and decision-making structures. For example, in 2015, the World Bank estimated that, globally, women represented only 22.9% of national parliaments. One of the central premises of the traditional perspectives that feminism has challenged is the exclusionary focus on areas that are considered "high" politics - for example, sovereignty, state and military security. The traditional focus on states and the relations between them ignores the fact that men are predominantly responsible for state institutions, dominating power and decision-making structures. It also ignores other areas that impact global policy and are impacted by it.

This is a gender exclusion, as women contribute in essential ways to global politics, although they are more likely to occupy areas not considered important politics and their daily lives can be considered peripheral. Traditional perspectives that ignore gender not only neglect the contributions of women and the impact that global politics has on them, but also perpetually justify this exclusion. If women are outside these realms of power, their experiences and contributions are not relevant. Feminist theorists have worked to demonstrate that this distinction between private and public is false. In doing so, they show that previously excluded areas are central to the functioning of RI, even if they are not recognized, and that the exclusion and inclusion of certain areas in traditional RI thinking is based on gender ideas about what counts. and what doesn't count.

The participation and leadership of women in politics and public life on an equal footing is essential to achieving the Sustainable Development Goals by 2030. However, data show that women's representation is insufficient at all levels of decision-making in the world. Therefore, achieving gender parity in politics is still a long way off.

Only 22 countries have women heads of state or government and 119 countries have never been chaired by women. At the current pace, gender equality at the highest levels of decision-making will not be achieved for another 130 years (ONU, 2021).\

Only 10 countries are chaired by a Head of State and 13 countries have Heads of Government. Only 21% of those holding ministries were women, and only in 14 countries did government offices reach 50% or more in female representation. With an annual increase of just 0.52 percent, gender parity in ministerial-level posts will not be achieved until 2077 (ONU, 2021).

The five ministerial portfolios most held by women are: Family / Children / Youth / Elderly / Disability, followed by Social Affairs; Environment / Natural Resources / Energy; Employment / Work / Vocational Training and Women's Affairs / Gender Equality (UN, 2021).

Only 25% of national parliamentary seats are held by women, a percentage which increased from 11% in 1995. Only four countries have 50% representation of women in the lower or single chambers of parliament. Rwanda, with 61%; Cuba, with 53%; Bolivia, with 53%; and the United Arab Emirates, with 50 percent. Another 19 countries have reached or surpassed 40%, including nine European countries, five from the Latin America and Caribbean region, four from Africa and one from the Pacific area. More than two-thirds of these countries have implemented gender quotas —whether legislated quotas for candidates or reserved positions— which have created space for women's political participation in national parliaments (ONU, 2021).

Worldwide, there are 27 states in which women occupy less than 10% of the available parliamentary seats in lower or single houses, including four countries with no women in their low / lonely houses. With the current level of progress, gender parity in national legislative bodies will not be achieved until 2063 . In Latin America and the Caribbean, Europe and North America, women occupy more than 30% of parliamentary seats. In North Africa, West Asia and Oceania, women represent less than 17% of parliamentary seats. Pacific island states have the lowest representation of women: they occupy only 6% of the positions and three countries do not have women in their parliaments (UN, 2021).

Data from 133 countries show that women constitute 2.18 million (36%) of the members of local decision-making bodies. Only two countries have achieved 50%, and in another 18 countries more than 40% of the local public service are women. Since January 2020, there have also been regional variations in the representation of women in local decision-making bodies: Central and South Asia, 41%; Europe and North America, 35%; Oceania, 32%; Sub-Saharan Africa, 29%, East Asia and Southeast Asia, 25%; Latin America and the Caribbean, 25%; West Asia and North Africa, 18% (UN, 2021).

The common goal adopted internationally in the Beijing Declaration and Platform for Action is to achieve political participation and the balanced distribution of power between men and women in decision-making. Most countries in the world have not achieved gender balance and few have set or met ambitious targets for gender parity (50-50).

Alluding to the 70th anniversary of the UN, President Dilma Roussef reaffirmed her belief in the organization's reform as a means of “resolving the current deficit in the Council's representativeness and legitimacy”. As an example, the speaker cites the cases of Syria and the Arab-Israeli issue as moments in which the Security Council found it difficult to deal with "the new challenges of the 21st century". In this context, the organization's reform returns to the center of the debate in a direction that seeks to “endow the Council with voices that are both independent and constructive” (Rousseff 2013, s/p). However, the expansion of actors on the decision-making stage tends to focus on “the expansion of the number of permanent and non-permanent members, and the inclusion of developing countries in both categories” (idem, s/p.).

A United Nations study by Radhika Coomaraswamy (2015) found that gender in peacekeeping remains politically and financially under-resourced, and gender elements of post-conflict reconstruction are still marginalized in missions. Women still experience high rates of post-conflict violence, are still excluded from peace processes and are still ignored in peacebuilding policy. This is demonstrated, for example, in national and international attempts to disarm post-conflict ex-combatants and reintegrate them into post-conflict society. This is an area of post-conflict politics that feminist scholars have routinely exposed as being highly gendered and exclusionary from women who were former combatants. Megan Mackenzie (2010) attributed this to constructed gender identities that downplay the idea that women are agents in conflict or involved in wars, rather than constructing them as victims with limited agency. In other words, they are subject to war rather than its actors.

there is strong and growing evidence that the presence of women leaders in political decision-making processes improves these processes. Women demonstrate political leadership by working across party divisions in women's parliamentary groups - even in the most aggressive political environments - and advocating for gender equality issues such as eliminating gender violence, enforcing parental leave and daycare services, retirement issues, gender equality laws, and electoral reform.

Importantly, the 52 UN Special Procedures were never conducted by a woman. Furthermore, never before has a female secretary general been in charge of the UN.

The numbers are compiled by Gqual, a campaign that nearly a dozen NGOs like the Center for Justice and International Law (Cejil) launched in 2015 at UN headquarters in New York, on the eve of the General Assembly of the Nations under the principle of that equality in international organizations must be considered "a right, not an aspiration". Its objective: to promote gender parity in international organizations, where the lack of equity “affects virtually all international courts and bodies charged with developing international law and human rights”.

All this when these organizations have a very significant impact on people's daily lives, on relations between countries and even on the fate of future generations. The female presence, diversity, gender balance are important for the impact and legitimacy of international justice (ARBIX et al., 2017).

It's not that no one is doing women a favor by letting them participate, it's about women being a valuable voice for these entities. They are not alone. The campaign already has almost 700 signatures in support. Among them are Swedish Foreign Minister Margot Wallström, Costa Rican Vice President Ana Helena Chacón, Iranian Nobel Peace Prize winner Shirin Ebadi, Mexican journalist Carmen Arístegui, Turkish jurist Basak Cali, from Kenyan Musimbi Kanyoro, director of the Global Fund for Women, or Indonesian Kamala Chandrakirana, from the UN Working Group on Discrimination against Women.

A basic justification for concluding that this lack of parity is wrong and must be corrected is the fundamental right of all people to non-discrimination and equality of opportunity. Specifically, the Charter of the United Nations, the Convention against the Elimination of Discrimination against Women, the commitment to the participation of women in peace processes, among others, refer to the right of women to access these spaces under equal conditions and without discrimination of any kind.

But this lack of parity must be corrected because the presence of a critical mass of women in these bodies

makes a positive difference. The female presence, adding diversity, experiences and points of view, improves justice, deepens debates, enriches decisions and transforms the capacity of these institutions to make decisions that represent everyone. Indeed, the absence of women erodes the legitimacy and impact of these institutions, something the private sector noted when arguing for the need to increase the number of women on boards of directors (ENLOE, 2017).

Since the approval of Resolution 1325 (2000) by the UNSC, the participation of women diplomats in the prevention and resolution of conflicts and in building peace, including in leadership positions, has become an integral part of the realization of the MPS agenda. Brazil's National Action Plan includes, among its objectives, increasing the participation of women diplomats in processes related to peace and international security, based on statistical data such as those contained in the 2015 Global Study, which highlights the presence of women in peace negotiations increase the probability that peace agreements will last at least two years by 20%, and the probability that they will last longer than 15 years by 35%.

In Germany, 37.1% of seats in the German Parliament belong to women: they remain under-represented. In an international ranking of female participation, Germany is in 22nd place out of 190 countries. The number of women in leadership positions at Germany's Ministry of Foreign Affairs has risen sharply in the last year, but they are still, as in Brazil, underrepresented in diplomatic missions abroad. The ministry will shortly name a new secretary of state, the second woman to hold that position, and has made a conscious effort to promote diversity, Maas said. The percentage of women in the second highest level of leadership is now 45%, down from 27% a year ago (REUTERS, 2021).

V. CONCLUSION

This work analyzed the role of women in international organizations from the agendas of female representation in the foreign policy projects of Angela Merkel and Dilma Rousseff and found that feminist perspectives on international relations, not just the way in which feminists built new epistemologies to rebuild the theory of international relations, but also its limitations, were essential to demonstrate that there is a possibility of making international bodies a parity.

Transcending this debate that we have exposed is more than a political academic in nature, it is the first step towards proposing a relationship between the two disciplines that will allow us to give a new meaning to the analysis of the international situation, and for that, it is necessary to leave the analytical theoretical debates, and starting to select, design or adapt practical methodologies that can be formalized and standardized to achieve the goal of the grading.

These methodologies aim to achieve better and effective conditions for the construction of a social, cultural, economic and institutional environment that contributes to the promotion of social gender equality. These strategies, often implemented by multinational organizations, and applied in the most diverse areas of economy, society and politics, can inspire and allow us to go beyond doctrinal debates. They can also allow us to identify opportunities to combine, collect and adapt other policy instruments and practical strategies for the promotion and advancement of equality, perfectly applicable to the disciplines of international relations; understood them not only as discussion communities, but as true social institutions that are characterized by male resistance to adopt innovations that favor equality.

The idea of building a framework for the generation of public policies is very efficient, as it would allow better possibilities of implementation in international relations for the construction of a common, flexible framework, allowing the construction of an epistemology with a transversal approach to international relations. However, so far, it is necessary to break the unavoidable commitment of institutions and people who are involved in the fields of decision-making in the field of international relations. For this, it would be necessary to start from a series of very specific requirements, such as: a) Political will; b) A specific gender equality policy in the State, articulating the idea that the personal is political and the State is international; c) Statistics that give a diagnosis to the base; whether old statistics explored with a gender methodology or new proposals elaborated with such methodology; d) An in-depth knowledge of gender relations and how they affect the International area; e) The involvement of the administration; f) Financial and human resources; and g) The participation of women in decision-making processes.

And based on these conditions, build public policies aimed at and designed specifically to solve the problem of the absence of a female vision in the field of international relations.

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Code Isn't Law

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Keywords*— *Code, Law, Criminal, Artificial Intelligence, Cryptography.

***Abstract*—** *Code [1] isn't, and never can be, Law because the law is a phenomenon of culture, created and directional to men. Code can only be a rule in the sense of being accepted or produce effects by and in some group, in some circumstances but never as an obliged system like the ones of sovereign states that are valid to all – criminal rules are obeyed by its members but do not have the power to generate an effect in a formal state judicial system. Moreover, codes generated by Artificial Intelligence from machines lack the fundamental necessity of validity that is to be created and legitimated by men.*

I. INTRODUCTION

This article has the intention to dialogue with a thesis written by Aaron Wright & Primavera De Filippi in its article "*Decentralized Blockchain Technology and The Rise of Lex Cryptographia*" and the following article written by Primavera De Filippi & Samer Hassan "Blockchain Technology as a Regulatory Technology – From Code is Law to Law is Code".

II. METHOD

This article has the intention to dialogue with a thesis written by Aaron Wright & Primavera De Filippi in its article "*Decentralized Blockchain Technology and The Rise of Lex Cryptographia*" and the following article written by Primavera De Filippi & Samer Hassan "Blockchain Technology as a Regulatory Technology – From Code is Law to Law is Code".

As proposed above, we are challenging the concept that decentralized and autonomous creation of rules by machines could set a kind of system of law, even though this new kind of rulemaking can be recognized as producing effects on the market, over people and governments.

"*With the widespread deployment of the global Internet network, new forms of regulation have emerged which increasingly rely on soft law (i.e., contractual agreements and technical rules) to regulate behaviors. As more and more of our interactions are governed by software, we increasingly rely on technology not only as an aid in decision-making but also as a means to directly enforce rules. The software thus ends up stipulating what can or cannot be done in a specific online setting more frequently than the applicable law, and frequently, much more effectively. This is what Joel Reidenberg has coined Lex Informatica (1992) —a concept which has subsequently been popularized as "Code is law" by Lawrence Lessig (1999).*"[2]

The authors start the idea exploring the concept of Lex Informatica to purpose its theory based on the emergence of the new way of production of rules, that are subsuming the users of the internet, based on the new technology of Blockchain:

In this case meaning as an array of languages composing a method standardized to communicate

instructions to a computer, involving a set of syntactic and semantic rules to be used to define a c

Blockchain Technology as a Regulatory Technology from Code is Law to Law is Code. Primavera De Filippi & Samer Hassan, CERSA/CNRS & Berkman Center for Internet and Society, Harvard University, Universidad Complutense de Madrid & Berkman Center for Internet and Society, Harvard University. https://arxiv.org/abs/1801.02507

More recently, new technology has emerged which might change the way we think about law. This technology is the blockchain, a decentralized, secure and incorruptible database (or public ledger) that constitutes the foundational tool for peer-to-peer value creation and trustless transactions. Introduced in 2009 with the Bitcoin network —as the underlying infrastructure for a decentralized payment system— the technology has rapidly evolved to acquire a life of its own.

Today, the blockchain is used in many other kinds of applications, from financial applications to machine-to-machine communication, decentralized organizations and peer-to-peer collaboration. As a trustless technology, the blockchain eliminates the need for trust between parties, enabling the coordination of a large number of individuals that do not know (and therefore do not necessarily trust) each other.

At the very end of the spectrum, the most recent blockchains have introduced the ability for people to upload small snippets of code (so-called smart contracts) directly onto the blockchain, for them to be executed in a decentralized manner by every node of the network. These rules are automatically enforced by the underlying technology (the blockchain), even if they do not reflect any underlying legal or contractual provision.

This is what brings us to the fourth phase —which is just beginning— involving a new approach to regulation, the code-ification of law, which entails an increasing reliance on code not only to enforce legal rules but also to draft and elaborate these rules. As a result of these technological advances, the lines between what constitutes a legal or technical rule become more blurred since smart contracts can be used as both a support and as a replacement to legal contracts.[3]

As mentioned by the authors in its article, the advent of blockchain technology has allowed the creation of "*smart contracts*" and created the real possibility of trustless transactions, peer-to-peer, which are letting the parties create "*legal contracts through technology, thereby effectively turning law into code*".

It is useful to the understanding of that discussion bring the concept of blockchain:

"*The blockchain is a distributed, shared, encrypted database that serves as an irreversible and incorruptible public repository of information. It enables, for the first time, unrelated people to reach consensus on the occurrence of a particular transaction or event without the need for a controlling authority*."[4]

And its technical concept:

Idem cit. 2.

YOCHAI BENKLER, THE WEALTH OF NETWORKS 62 (2006) (hereinafter "Wealth of Networks")

"*A blockchain is simply a chronological database of transactions recorded by a network of computers. Each blockchain is encrypted and organized into smaller datasets referred to as "blocks." Every block contains information about a certain number of transactions, a reference to the preceding block in the blockchain, as well as an answer to a complex mathematical puzzle, which is used to validate the data associated with that block. A copy of the blockchain is stored on every computer in the network and these computers26 periodically synchronize to make sure that all of them have the same shared database*."

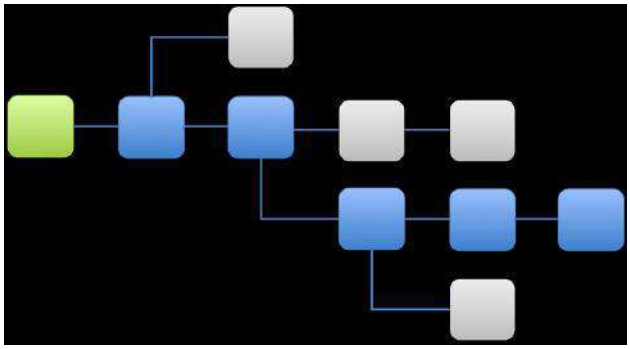


Fig. 1. A graphical representation of the blockchain

Going beyond, the thesis raised by the authors sustains that we are at the edge of a new system, called by them Lex Cryptographia – "*rules administered through self-executing smart contracts and decentralized (autonomous) organizations*".

First of all, it is important to overlap the hodiernal concept of law adopted for this article, assuming here that Law is always referring a certain period of history, in a given society to a certain array of values – axiomatically ordinated, designed and targeted by the members of that given society to be applied, coordinate and obey them. Objecting Reale's Formula that "*Law consists of norms, whose understanding is not possible without taking into*

account their social connection and the values that are realized in it."

Assuming the culturalism proposed by Gustav Radbruch in its Philosophy of Law and the tridimensional Concept of Law presented by Miguel Reale, conceiving a polarity and dynamism between history and culture – fact-value-norm.

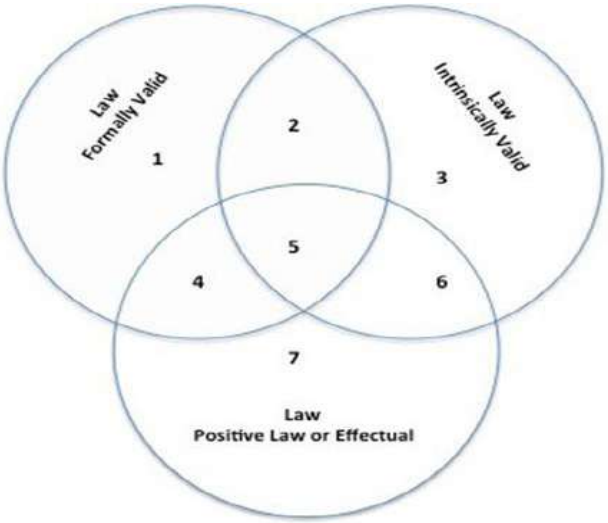
Law is a phenomenon of culture5 and, about Radbruch, "*the idea of Law is, without doubt, a value; Law, however, is not a value, but a reality referred to values, namely, a cultural fact*".

Thus, the emergence of the so-called Lex Cryptographia cannot be classified as Law or, even, as a subsystem of Law. The confirmation of the existence of this new kind of rules and its particular way of construction – directly by digital codification, in some cases automatized using Artificial Intelligence -, notwithstanding its self-executing characteristic that imposes a "*pre ante*"

[5] "*[...] culture could be viewed as an amalgamation of potentially related and relatively durable societal characteristics that describe an identifiable human population, such as a nation or ethnic group*."

enforcement of its provisions, this is not sufficient to elevate this praxis as a system or body of Law.

To clarify this division, it is useful to present some of the thoughts of the philosophy of Eduardo García Máynes and his radical perspectivism:



As he explains, the Law Intrinsically Valid is the Law as Just, fundamentally fulfilled of ethic; the Law Formally Valid it is the one in force, that has observed extrinsic criteria to be seen as in force; and the Positive Law, regardless its lack of observance of criteria to be seen as in force, it is not if no the Effectual Law, that is to say, effectively performed in a given community.

So, it is possible to have a positive law regardless of its absence of force – here understood as a set of norms that haven't observed formal and extrinsic criteria of a given system of law of the sovereign state.

The simple emulation of rules set in a digital codification, despite its appliance and enforceability, is far from the creation of a body of law, because, as mentioned above, the lack of legitimacy and the absence of a given sovereign state to give force moves away from any possibility to classify those rules as a system – or even a subsystem – an of law.

The precipitation of this new set of rules and the possibility of rulemaking by machines with artificial intelligence brings a huge sort of problem for the national systems of law and their correlated states.

Furthermore, it is preoccupancy that machines can automatically change or reset rules that are self-applicable and has, in many cases, auto- enforceability.

Looking ahead, these digital autonomous rules are challenging many of the rights of people in many states, considering an array of points of view – e.g., consumers,

small companies, minors, and persons with relative capabilities (i.e., in the law sense).

As mentioned in the article discussed here, these kinds of problems are not new. In the emergence of new technologies states are defied to find out solutions to constrain the agents of the market to observe and obey their system of law – e.g., Communications Assistance for Law Enforcement Act (CALEA).

The United States has made several restraints to the communications providers in order to control risks of inobservance of law and to reinforce the persecution against criminals and terrorists.

Thus, the usual forms of controlling and regulation, e.g., using of coercive force, financial incentives and disincentives, social pressure or pressure over the intermediaries and providers of connection are under scrutiny now, regarding the challenge to trigger and restrain a new technology that is spread out in many decentralized computers and networks.

The main objective of this essay in dialogue with the aforementioned articles is to consider and weigh that despite the irradiation and effects that this new form of production contracts and rules – that, as mentioned, can be produced digitally and independently by machines with self-coerciveness – cannot be assumed or confused with a system or body of law.

The fact that the deployment of technologies and the use of Internet networks can create an environment that commercial provisions translated to a digital code that can restrain human behavior bring serious concerns to all.

The fact that, practically, everyone can create a digital code – and in this sense produce rules self-executed and with coercive effects – is an enormous challenge to defeat.

Considering a level of knowledge, anyone can modify or implement new digital codifications, creating "smart contracts" that can regulate and shape the behavior of users in the Internet network. It is not much to say that an important part of the assets and lives of many are submitted or even contained in the virtual world.

Blockchain technology can impose limitations to individuals and enforce its provisions ex-ante, taking into consideration the fact that those smart contracts can avoid breaching of rules – considering the most majority of individuals that lack the knowledge to unpin from the obligations imposed by these new technologies.

Another point to mention is that these new technologies once used by large multinational companies with the support of their home nations can reproduce a new form of colonization over undeveloped nations.

"*The idea of moral character as the nucleus of civilized conscience-consciousness was developed in two directions. On the one hand, a moral character defined the international jurists themselves and bound them into a transhistorical fraternity of aristocratic heroes. On the other hand, it was projected on collectiveness and gave the measure whereby their civilization could be measured to determine, for example, whether they qualified for entry into the family of nations. In its former role, moral character was emphasized in the discussions of the writings of earlier jurists. Here is how Sir Travers Twiss discussed Vitoria's and Las Casas' defense of the Indians*:

It is difficult for us, in the present age, to measure the degree of courage and noble principle which impelled these excellent monks to vindicate the right of the oppressed against the authority of the Church, the ambitions of the Crown, the avarice and pride of their countrymen, and the prejudices of their Order."[6]

Here is precisely interesting mentioning the advent of the new pivoting of the so-called Non-Fungible Tokens ("*NFT's*"), in our view, this can mean an entire revolution in the intangible assets and, even, in real assets that could be identified and traded by an NFT.

NFT's could be defined as a digital asset, under a codification-based computational blockchain ledger that can demonstrate the ownership and authenticity of the related asset that is used to frame. The idea of the classification as "*non-fungible*" is to differ from other digital assets – this role is not uncommon due to the regular use of public documents, that are emitted and custodies by public institutions and authorities. An NFT providing it is a unique asset—for example, real property titles, cars, houses, and other merchandise, as well as digital assets such as images, documents, videos, and tweets can represent almost anything.

The use of blockchain technology with this particularity of NFT's can accelerate and even eliminate all kinds of intermediaries and the easy possibility to fraction the ownership can build a myriad of utilizations.

In the sense of Law this technological revolution can bring back operative areas and businesses declared as dead (like music companies, editors, "printers", publishers), due to the use of those intangible assets that can be framed, restricted, charged, and pursued in any platform all around the world.

The Gentle Civilizer of Nations – The Rise and Fall of International Law 1870-1960 – Martti Koskenniemi – Hersch Lauterpacht Memorial Lectures

"Just about every industry has been significantly transformed in the past few decades. But few have been as disrupted as the music industry. Everything seems to be changing at once, from the way content is produced and delivered, to the sources of revenue and profits. Digital technologies, - the Internet, smartphones, cloud computing, … - have turned dollars into pennies. Now, blockchain and related technologies may once more play a major role in the music industry, - this time helping to turn those pennies back into dollars.

We're truly surrounded by music as never before, - in a wide variety of styles; in physical and digital formats; over the Internet, satellite, and broadcasts; in mobile devices and home music systems. But the shift from physical to digital, and then from downloads to streaming have wreaked havoc on the business of music. US retail revenues of recorded music were close to $14 billion in 1998 before starting their decline. According to the Recording Industry Association of America (RIAA), revenues fell from roughly $12 billion in 2006 to around $7 billion in 2010. They stayed flat at $7 billion through 2015, starting to increase in 2016 mostly due to a growth in paid streaming music subscriptions. Revenues are expected to be around $8 billion in 2017." (Irving Wladawsky-Berger, former VP of Technical Strategy and Innovation at IBM - https://open-music.org/blog/2018/1/8/blockchain-and-the- music-industry-turning-pennies-into-dollars)

None of the bodies of laws are prepared to deal with this innovation, in this regard it will be necessary plenty of new rules and procedures to regulate and systematize the application and use of NFT's. Many questions arise in a prompt look, the NFT will be treated as a commodity or security? In the case of intellectual property do the transference of the ownership of an NFT will carry the intellectual property together – including the right to use, copy, display and modify the content?

Some other issues will be in need to deep scrutinized like cybersecurity (regarding the protection of passwords and movement of the assets), regulation against misusing in money laundering, yet the using of those assets as transference of money, profits and dividends to avoid taxation and other compliance duties before national authorities around the world.

Fig. 2. NFT Trasaction Value

[7]The numbers are soaring and the changing of use in the markets will pressure all the regulators to properly address the new set of contracts and rights emerging from NFT's uses.

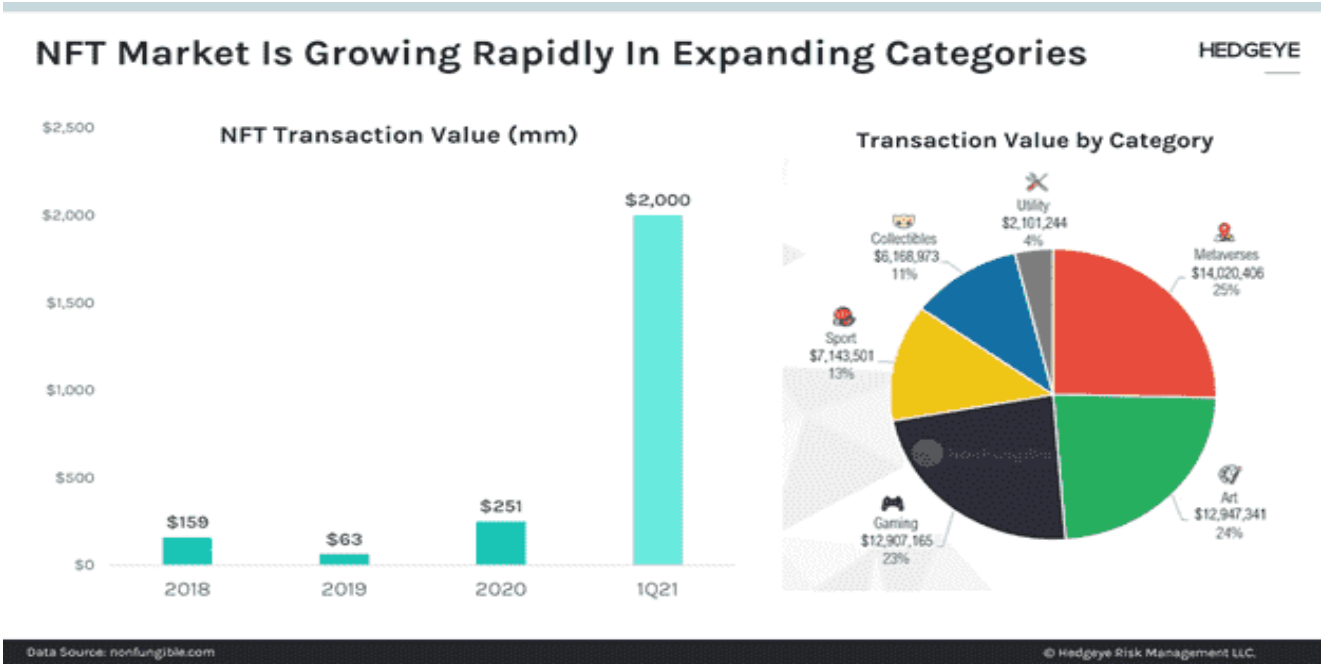


Fig.3. NFT_Collectible TokensMarket Capitalization

[8]So, notwithstanding our understanding that blockchain technology does not represent a new body of Law, it is clear that a new revolution in contract tools

[7]*https://www.forbes.com/sites/youngjoseph/2021/03/29/nft-market-rages-on-nfts-market- cap-grow-1785-in-2021-as-demand-explodes/?sh=409113167fdc.*

[6]*https://app.hedgeye.com/insights/99358-chart-of-the-day-the-nft-market-is-growing-rapidly?type=macro%2Cmarket-insights.*

and businesses will represent a complete change in the way regulators and authorities may operate from now.

Another aspect that concerns is that those new appliances can deeply amplify the distance between developed and underdeveloped countries, meaning new kinds of domination and increasing the social differences and distribution of wealth.

We are on the edge if not well addressed by nations before one of them never imagined tools to impose culture and purposes over non-prepared nations, meaning the worst forms of control, domination, and in the final sense, colonization.

In a world that is seeing pandemic crises, proxy war out of control of failed states, immigration of millions and a lot of pressure over social support in developed countries, added by this new division of work and a profound relegation of millions of adults out of these new technologies fields – representing that some are very well paid and becoming rich but millions are not prepared to deliver the required works and knowledge of this new industry.

These problems will test and challenge the body of Law of all countries, one of the tasks that will take huge efforts will be the definition and coordination to mitigate the overlaps in legislation to avoid the usage of agents transitioning among jurisdictions looking for better places to mitigate taxation, cover illegal usages and maximizing abuses over consumers and users.

In the proper field of legal theory, relying on a type of regulation of transactions and relations among physical persons, entities, companies, machines and public institutions shall impose an unimagined plead of gaps and questions over practical interpretations and applications of the commands carved in digital "*smart contracts*". All sorts of designed clauses are made to oblige the signors of a contract to observe some array of obligations (command) and to suffer punishment for breaches (control).

We are far distant from a legal theory establishing or even proposing a technical procedure to interpret a legal disposition – mainly because in a semiotic sense the symbolic production of meaning involves a plenty of usage of tools for communication and a kind of poetic-creative interaction between the parties to construct the scenario that will frame the expected behavior.

So, if it is no feasible assume a theory to stabilize a proper interpretation it seems practically more difficult – in opposition on what mainly all prophets of blockchain

and technology revolution reverberates – to determine what would be the correct interpretation for dispositions that may will be under dispute between a non-observed contract disposition.

As briefly showed above, it seems for us that we are not before a new body of law, but, like any revolution the "*earthquake*" will shake down many procedures and challenge institutions, governments and all actors dealing with those tools in near future, this will demand an enormous work to adapt and build regulations that can absorb those contemporaneous ways to contract, protect individuals, social interests, human rights and soften the arisen differences that will surge among citizens and nations.

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An acknowledgement section may be presented after the conclusion, if desired.

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Preventive extraction of the lower third molar: Literature review

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***Keywords*— Extraction, third molar, complementary exams.**

***Abstract*—** *Third molar extraction is one of the most effective procedures in oral surgery. His recommendations are associated with caries, periodontal disease, pericoronitis, root resorption, crowding and dentigerous cyst. The appropriate period to choose whether or not to extract third molars is also controversial, and a method for predicting impaction of these teeth has not yet been scientifically legitimized. Objective: to carry out a literature review to address, explicitly and clearly, the main problems in which the extraction should be suggested in a preventive way, and some relevant complementary exams that facilitate the surgeon at the time of removal. Methods: A literature review study was carried out. The study report was organized according to the preferred reporting item criteria for systematic reviews and meta-analyses (PRISMA). The study was carried out by searching the following databases: PUBMED, Cochrane Library and SCIELO (Scientific Electronic Libray Online) in Portuguese and English vernacular. Results: The inclusion criteria for the study were the selection of articles that addressed the topic, whose texts were complete and free, published in English or Portuguese. Those who did not show the subject addressed in this review in the title, abstract and/or text were excluded, as well as those with more than 20 years of publication. Conclusion: The suggestion of third molar extraction should be made in accordance with the system of each patient, taking into account the assessment of the question of risk x benefit.*

I. INTRODUCTION

The third molar has its crown formed around sixteen years old, approximately, between seventeen and twenty-four years old, the tooth erupts in the oral cavity, and finally, at twenty-five years old, the maturation of the roots occurs (LOPES, 2018). This ends the permanent dentition, as the third molars are the last teeth to form. (PRADO, 2016).

Third molar extraction is the most common operation performed by oral and maxillofacial dentists. Therefore, some studies are looking for the right time for surgery, as any surgery determines discernment and precept. From this perspective, most health professionals are confident about the conditions in which they need to extract their third molars. (GOMES et al., 2004; SILVA et al., 2010).

Removal of third molars are procedures that appear more often in clinics, whose literature itself is still questionable when it comes to the decision to extract or not the third molars as prevention. What is known is that when extraction is indicated, the dentist must have a

reasonable justification for carrying out the patient's treatment plan. (NORMAND, 2015).

According to Marciani (2007), when clinically or radiographically analyzing cases of acute or chronic periodontitis, tooth decay or pericoronitis, or when they interfere with adjacent teeth due to their angulation and position, it is necessary to extract the third molar. Considering periodontal disease, if not treated in time, it can harm the patient's general health.

Due to these factors mentioned above, the patient can probably report pain, discomfort, halitosis, bleeding, difficulty in opening the mouth and other symptoms, which are the main reasons that lead a surgeon to reflect on the asymptomatic removal of impacted molars. (CANDIDO et al., 2014).

Therefore, after third molar removal is prioritized, additional exams are essential for performing surgical operations. Panoramic radiography has proven to be an agile and diligent mechanism to visualize dental anatomy (root formation and recognition), anatomical structures (such as mandibular canal), etc.

Furthermore, the requirement for preoperative inspection is essential to guide the specialist in correct tooth extraction. It is even possible to add post-operatives through image inspections. (SILVA; PASSOS, 2015).

Therefore, the aim of this study is to carry out a literature review to clearly and unequivocally resolve the main problems that should be used as a preventive method for tooth extractions, as well as some related complementary exams that help the surgeon in tooth extraction.

II. LITERATURE REVIEW

2.1. Third molar development and classification

According to Graziani (2015) genetics, climate and diet are some of the factors that affect this chronology. Therefore, it is necessary to establish inherent patterns for each region where the above variables differ greatly. Regarding the development of posterior teeth, the position of development of the first molars is close to the point of eruption in the dental arch. According to the author, during the development of the second and third molars, the growth of the mandible and maxilla is not enough to contain the bacteria in these teeth.

To facilitate surgical operations, Winter (1926), Pell and Gregory (1933) performed the classification of third molars. The first author classified third molars according to the inclination of their long axis in relation to the long axis of second molars, and determined the following content groups: vertical, mesioangular, distoangular, horizontal, vestibuloangular, lingual and inverted, and Pell and Gregory developed two different classifications for impacted third molars: one to determine the position of the lower third molar in relation to the ramus of the mandible (Class I, Class II or Class III) and the second related to the occlusal plane of the second molar (position A, position B or position C) (SANTOS et al., 2009).

During the eruption process, impacted teeth are somewhat evidenced due to some obstacle in the oral cavity in this process. Limitations may be due to genetic abnormalities, excess soft tissue, dense bone coverage, and inadequate placement of adjacent teeth. However, it should be noted that the third molar is the tooth with the highest percentage of impaction. Therefore, it is necessary to assess the consequences of tooth preservation and perform preventive extractions to prevent possible complications in the future (ANTES, 2016; GONDIM et al., 2010).

2.2. Possible complications involving third molars

To facilitate the understanding and approach of the literature search, possible complications that can affect lower third molars were developed through topics, as follows:

2.3. Periodontal disease - pericoronaritis

According to Stasse (2009), pericoronitis is an acute or chronic inflammatory condition of infection or trauma of the soft tissue (alveolar coverage) to the contour of the teeth. It is often related to semi-enclosed third molars, and more continuous in lower third molars. Delayed tooth eruption and tooth impaction can be the predisposing agents, affecting more often adolescents and young adults, and it is one of the most common infection processes in the oral cavity. This condition usually leads to the removal of semi-enclosed teeth, which predominates in the age group between 20 and 29 years (MOLONEY; STASSEN, 2009).

The occlusal surface of the affected tooth is commonly surrounded by gingival tissue called the operculum, which allows the accumulation of food and the spread of bacteria, causing pain, bleeding, bad breath and trismus. If treated satisfactorily, this process will only persist for a few days, however, if ignored, there is a risk of aggravation due to the spread of the infection. The treatment of pericoronitis varies according to the degree of infection of the periodontal tissue. (AGUIAR, 2015).

Pericoronitis can also be caused by a mild trauma of the upper third molar in the superficial mucosa that medially covers the semi-enclosed lower third molar, causing its swelling, which further benefits the trauma to the area. The cycle is only interrupted when the upper third

molar is removed (DUARTE, SATO and MORAES, 2007).

Pericoronitis can present with early symptoms, such as anorexia, fever and difficulty chewing. In these cases, removal of the third molar is recommended. In addition to the above signs, infections can also have more serious complications such as adjacent tooth decay, tumor problems and even neurological problems. Based on this, it is necessary to previously evaluate the pericoronitis and the treatment of adequate antibiotic therapy, such as the use of analgesics, antibiotics and anti-inflammatory drugs. (TELES, 2013; MARTINS ET AL., 2010).

According to this study Costa et al. (2012), partially erupted third molars have a greater possibility of pericoronitis, therefore, they are indicated for preventive tooth extractions.

2.4 Cyst and dental tumor

When the impacted tooth is completely retained in the alveolar process, the associated follicular sac is almost always present. Although, in most patients, the dental follicle retains its original size, it may suffer cystic degeneration and become a dental cyst or keratocyst. If the patient is closely monitored, the dentist can diagnose the cyst before it reaches a large proportion. Odontogenic tumors can originate from the epithelium contained in the dental follicle, being the most common ameloblastoma in this area. (HUPP et al., 2015).

According to Steed (2004), some patients with retained third molars develop odontogenic cysts and tumors, although they are relatively rare. Many are asymptomatic, only discovered accidentally during radiographic examinations. In patients older than 20 years, cystic changes can be found on histopathological examination of soft tissues associated with asymptomatic retained third molars. Although many of these lesions can be caused by inflammation associated with recurrent pericoronitis, they are often misdiagnosed as examples of dental cysts, especially as they cannot be determined since odontogenic cysts affect any teeth. (STEED, 2004).

The treatment of small lesions distant from the anatomy (such as the alveolar nerve) is carried out with care, removing the cyst and removing the retained tooth. Usually the removal indication is given by the element that has not broken and there is not enough clinical space for the performance of its masticatory function. The larger the cyst, the greater the risk of injury to the nerve root and the angle of the mandible, after surgery the operated area may suffer limitations and weakening. The treatment, in this case, will be a decompression operation, followed by enucleation, after reducing the size of the lesion itself. Most dental cysts have a good prognosis and recurrence is rarely found after complete removal of the cyst. (HOCHULI-VIEIRA, 2013).

2.5. Anter-bottom crop

Anteroinferior crowding occurs a lot in the incisors, and when there are no spaces for the teeth to be accommodated due to lack of spaces, they start to protrude or rotate, this usually occurs in late adolescence, being able to coincide with the eruption of the third molar (SILVA, 2010).

Several authors believe that the etiology of lower anterior crowding is multifactorial, and that it is important that during the diagnosis and treatment plan, factors that may influence the recurrence are identified, developing an individual treatment and containment protocol, according to the needs of each case (GOMES, 2007).

Among these multifactors, they mention: late mandibular growth, skeletal structures and growth pattern, in addition to soft tissue maturation, periodontal forces, dental structures, occlusal factors, changes in periodontal ligament, mesial migration of posterior teeth, deleterious habits, pressure of the teeth. perioral tissues, osteodental discrepancies, absence of interproximal wear and growth pattern (GOMES, 2007; SILVA, 2010; MARIGO, 2011; GRESSELE, 2014; MACIEL, 2006).

Orthodontists take into account that the lower third molar can contribute to the aggravation of the problem when combined with another of these factors (FERNANDES, 2011).

Symptomatic third molars should always be removed; third molars in development must be followed every two years until 18 years of age, after 18 years the patient must be followed annually (ARTESE, 2006).

General practitioner dentists recommended the extraction of third molars in 59% of their patients, mainly to prevent potential problems or because the placement of the third molar was unfavorable or its eruption was unlikely, much more so than orthodontists (NORMANDO, 2015).

2.6 Radicular resorption

The presence of the third molar can culminate in several consequences if positioned irregularly, depending on the intraosseous position and depth. When there is direct contact with the second molar in relation to the mesioangular or horizontal inclination, there are great chances of coronary or root resorption, especially at the root of this tooth element, resulting in abscess or necrosis formation (LACERDA; SANTOS, 2018).

This included tooth element, which develops below the adjacent tooth, can weaken the root of the neighboring

tooth, reducing its volume and causing instability in chewing. This can lead to the loss of a healthy tooth, which will compromise the positioning and functionality of the entire arch. (LACERDA; SANTOS, 2018).

Root resorption in permanent teeth is a pathological process, and early diagnosis and knowledge of its causes are necessary factors to define the best treatment to be performed. This reabsorptive process occurs through two mechanisms:

First, inflammatory resorption, when cementoblasts are removed, exposes the mineralized root surface. This process is observed in impacted teeth, in which the coronary portion comes into contact with the root structure of the adjacent tooth, so that bone cells promote the loss of bone tissue, an included dental element that develops below the adjacent tooth, can weaken the root of the neighboring tooth, reducing its volume and causing instability in chewing. This can lead to the loss of healthy teeth, which will compromise the positioning and functionality of the entire arch (LACERDA; SANTOS, 2018).

The second mechanism occurs through replacement resorption, when periodontal structures are replaced by bone, causing ankylosis and, consequently, bone deposition gradually resorbs the root. The main therapeutic method for root resorption is the elimination of the cause, third molar extraction (LACERDA; SANTOS, 2018).

2.7 Dental caries

Dental caries can happen in the third molar or in the second molar, and because they are very close, caries is constant at the cervical level. Many patients do not have good effective oral hygiene in the most posterior area of the oral cavity due to the anatomical location, and because this area is a difficult access for a restoration, for this reason tooth decay is responsible for the indication of wisdom teeth extraction included in approximately 15% of patients (PETERSON et al., 2004).

Due to its high prevalence, tooth decay is considered one of the main public health problems worldwide. Early assessment and analysis of the risk of caries already affecting third molars, and/or associated with second molars, is necessary for the treatment (TORRES et al., 2008).

Caries is a multifactorial disease, the oral bacterial flora is capable of forming a biofilm on the surface of the tooth due to lack of care with oral hygiene. Fluoride will act in the prevention and control of caries, as well as diet and supervised brushing (FEJERSKOV, 2004).

The deep occlusal fissures of third molars, the position of where it is in the arch, and the anatomy of the occlusal surface are vulnerable to biofilm accumulation. Failure to remove this bacterial plaque can affect caries. (SHUGARS et al., 2005).

A study carried out by Falci (2005) analyzed 246 periapical radiographs from the Department of Maxillofacial Surgery at UFVJM, Diamantina, Minas Gerais. In it, the incidence of caries in the interior second molars was evaluated due to the presence of third molars – wisdom – semi-included, which are partially erupted in the oral cavity. In this study, patients aged between 23 and 57 years were 2.8% more likely to have second molar caries associated with semi-enclosed third molars than patients aged between 16 and 22 years (FALCI, 2005).

Also according to Falci (2005), age is one of the factors to be analyzed and considered in the early extraction (patients under 22 years old) of indications for an impacted or semi-impacted tooth.

This indication can be made when diagnosing the presence of bacteria and confirming that there is no room for an eruption. Other important factors for the presence of second molar caries associated with semi-embedded wisdom teeth are the location of the semi-impacted third molar and the patient's gender. Statistically, male patients have more prevalence of tooth decay in this area than female patients (FALCI, 2005).

2.8 Complementary exams

2.8.1 Panoramic radiography

In current dentistry, complementary imaging exams are essential for patient diagnosis, treatment planning and protection. In this case, in addition to facilitating the analysis and classification of the third molar, panoramic radiography is the gold standard for evaluating the maxillary complex, the entire alveolar region and adjacent structures. After considering and analyzing all the above factors, if there is an indication for surgical resection, the intervention needs to be planned correctly, depending on the position of the unperforated tooth (GATNER; GOLDERNBERG, 2009).

In most cases, the classification of third molars is done by radiographic analysis, using periapical radiographs, or more commonly panoramic radiographs, through which the long axis, mandibular ascending ramus and second molar bone can be visualized this creates a classification parameter and it is possible to assess the possible risks associated with the procedure. Panoramic radiography is most used for diagnosis and surgical intervention, prioritizing ease of access and cost-effectiveness (GARTNER; GOLDENBERG, 2009).

2.8.2 Computed Tomography

In dentistry, computed tomography is widely used, mainly used to identify and describe pathological processes, such as benign and malignant tumors, cysts, and may also show residual teeth, trauma, sinuses, joint skeletal components and dental implants (RODRIGUES; VITRAL, 2007).

Computed tomography can be used to identify cortical bone perforation or invasion into adjacent soft tissues, it can record regional lymph nodes in cases of staging of malignant tumors. It enables the evaluation of odontogenic cysts and the location of foreign bodies. This exam defines the morphology and extension of cystic lesions (RODRIGUES; VITRAL, 2007).

When the examination is performed with slices less than 1.5 mm thick, it is possible to visualize the shape and position of the impacted tooth, as well as lesions in neighboring permanent teeth. If the space of the periodontal ligament of the tooth is visible, orthodontic intervention is possible (RODRIGUES; VITRAL, 2007).

Computed tomography is the exam of choice in the diagnosis of many conditions that involve the maxillomandibular complex; some principles must be respected before choosing the exam to be ordered: knowing what you are looking for, knowing the technique that will best visualize the tissue to be observed, being minimally invasive, exposing the patient to the minimum radiation possible, avoiding unnecessary expenses and always start studying with the simplest technique (RODRIGUES; VITRAL, 2007).

III. METHODOLOGY

The methodology of this work is presented as a descriptive analysis research bibliographic through a literature review. It is characterized by selecting articles that talk about the selected topic. To help with this research and selection of articles, we use a database search.

In the searches in the virtual database, words such as “extraction”, “third molar”, “prevention” and “third molar included surgery” were used.

The PubMed and Scielo databases were consulted, in addition to clinical articles related to the subject, selecting references from 2001 to 2021, in English or Portuguese. Through this research, the researchers had contact with several published materials in the last two decades, in order to better understand the controversies, the positive and negative facts about the material studied.

IV. DISCUSSION

Third molar extraction is one of the most common procedures in oral surgery. According to Rodrigues (2007), it is estimated that approximately 5 million people have 10 million teeth removed each year. Reasons for third molar removal include caries, pericoronitis, periodontal problems at the distal end of the second molar, odontogenic cysts, and crowding.

In this sense, Table 1 shows the main thoughts, as well as the theses defended by authors about third molar extraction.

According to Aguiar (2015), the extraction of impacted or semi-impacted third molars prevents future pathologies, including caries, root resorption, periodontics, cysts and odontogenic tumors, and the non-removal, that is, the permanence of a Included third molar, even relatively erupted, being adjacent to erupted teeth induces the grouping of bacteria, thus forming a bacterial niche where it becomes an adequate medium for the formation of periodontal pockets, and when it is established it is capable damage or even compromise the third molars and may affect the second molar.

Table 1: Main lines of reasoning defended by authors about third molar extraction.

Author	Year	Objective	Discussion
AGUIAR, ASW	2015	Know the surgical processes in third molar extraction	Evaluation of the degree of mouth opening and postoperative pain after removal of retained lower third molars
CARDOSO, V	2012	Scientifically discuss through published literature about complications in third molar removal	Complications and accidents in Third Molar Surgery
MEDEIROS, PJ	2013	Know the surgery procedures for impacted teeth	Through reports of clinical cases experienced by the author, it was possible to know the surgical procedures

			of impacted teeth
VANDER LINDEM	2014	Know the theoretical and clinical aspects of crowding in human dentition	Through the literature available for consultation, it was possible to evidence the relationship between dental crowding and third molars
GRAZIANI, M	2015	Knowing maxillofacial surgery procedures in treatments for third molar extraction	Through literature available for consultation, it was possible to evidence frequently used techniques for wisdom tooth extraction.
CANDIDO, N	2014	Know the relationship of Pericoronaritis: diagnosis and treatment with third molar extraction	Evidencing through published studies the relationship of inflammatory processes that lead to the extraction of wisdom teeth.
SANTOS, A	2018	Know the relationship of dental resorption versus third molar	The presence of the third molar can culminate in several consequences if positioned irregularly, depending on the intraosseous position and depth.
TORRES, F	2018	Analyze third molar extraction in caries	Caries is a multifactorial disease, the oral bacterial flora is capable of forming a biofilm on the surface of the dental element due to lack of oral hygiene care

According to the study carried out by Cardoso (2012) in the first episode of pericoronitis, it should not be considered as an indication for extraction, as it is not plausible to perform them without further specific conditions. However, according to this study Medeiros. (2013) recognizes that third molars with indications of an episode of pericoronitis must be extracted, because most of them will worsen.

Vander Lidem (2014) and Graziani (2015) claim that the presence of impacted teeth in the alveolar bone represents a greater risk of odontogenic cysts and tumor development, but there is no correlation between the prevalence of these lesions and impacted teeth. Therefore, it is wrong to extract such teeth as a prevention mechanism for odontogenic cysts and tumors (GRAZIANI, 2015).

According to Santos (2018), when there is direct contact with the second molar in relation to the mesioangular or horizontal inclination, there is a high chance of coronary or root resorption, especially at the root of this tooth element, resulting in abscess or necrosis formation (LACERDA; SANTOS, 2018).

In agreement with Silva et al. (2010) and Portela; Almeida (2020), infer that the lower anterior crowding is not exclusively related to the eruption of the third molar, since the reasons for this event are diverse. In view of this, extraction in these cases is not indicated or even scientifically corroborated.

According to Torres et al. (2018), due to its high hegemony, dental caries are analyzed as one of the main public health problems worldwide. Prior evaluation and diagnosis of the risk of caries already affecting third molars, and/or adjunct to second molars, is essential for treatment (TORRES et al., 2018).

Dentists should consider that surgical complications motivated by the extraction of third molars are common (KANDASAMY et al., 2009). These involve: excessive pain, paresthesias, bleeding, alveolar osteitis, bruises, dehiscence, edema and locked jaws (FRIEDMAN, 2007).

Although, it is considered uncommon, there are hundreds of narratives in the literature about mandible fractures after third molar extraction (RODRIGUES et al., 2013).

Thus, the risks and benefits of performing the surgery need to be considered, taking into account the cost of performing the surgery by a dentist in a private or public clinic (Brasil, 2008), in order to establish a duty to the system without prevent the advantages and tautochronous disease.

Bioethics and its principles can guide the behavior of health professionals and help them to make decisions in conflict situations. Surgeons need to consider the principle of no harm and avoidance of all types of injuries. (GALVÃO et al., 2010).

Finally, Santos (2008) reinforces that imaging tests, such as regular radiographs and CT scans, should be used in the pre- and post-surgical procedures to be performed, as they serve as a guide for planning surgeries . Furthermore, in some cases, close contact between the third molar and the mandibular canal may require a more specific examination than two-dimensional radiography. Therefore, the use of computed tomography shows a lower degree of anatomical deformation.

Therefore, it is necessary to carefully consider and analyze whether preventive tooth extractions will bring more harm than the actual benefits proposed, as described above.

V. CONCLUSION

At the end of the work, it is possible to point out that:

1. The third molar may even have some influence on the installation of malocclusion, although it is insignificant;

2. Previous removal of the third molar due to lower anterior crowding does not present scientifically proven evidence.

3. The etiology is multifactorial and seems to be more linked to late mandibular growth;

4. There is no need to request extraction as a prophylactic procedure, unless the third molar is involved in moderate or severe pericoronitis, caries, cysts, tumors or second molar root resorption;

5. For an accurate surgical procedure to occur, results obtained through imaging tests such as traditional radiography and computed tomography are required.

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Transportation Network and Road accident analysis: A case study of Khandwa city

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***Keywords*— Accident severity Index, Black spot, Transportation models, Trip, Impact Factor.**

***Abstract*—** *The design and construction of any road section would remain incomplete without proper transportation planning process. With the case study of Khandwa through transportation model it became possible in identifying need, advantages, disadvantages and challenges while designing future Transportation infrastructure. The study was done taking transportation system of Khandwa. In which four transportation models: Trip generation, Trip distribution, Modal split, Trip assignment was generated for all 6 zones. After the assessment network diagram depicting traffic population of selected three modes of vehicles was obtained. Also the Road accident analysis was carried out in the same region using QGIS software.*

I. INTRODUCTION

Travel forecasting models are used to forecast changes in travel patterns and transportation system utilization as a result of changes in regional development, demographics, and transportation supply. Transportation network modeling involves four step procedures: Trip generation, Trip distribution, Modal Split and Trip Assignment. The goal of the study is to analyze transportation network modeling of Khandwa city.

According to the United Nations, one death occurs every four minutes on Indian streets, making it the world's most accident-prone country. Increasing population density leads to higher risks in road accidents. The studies have been conducted to analyze road accidents occurring in Khandwa city, location of black spots using QGIS software.

II. OBJECTIVES

This research paper aims to create transportation network model and Road accident analysis of Khandwa city of Madhya Pradesh. Through this study traffic population have been forecasted for next decade for 3 modes of transport i.e. cars, 2-wheelers and Rickshaw. While accidental analysis is done to find out black spots and accident severity index.

III. METHODOLOGY ADOPTED

The broad methodologies adopted for this complete research study have been shown through a flow chart given in Fig. 1.

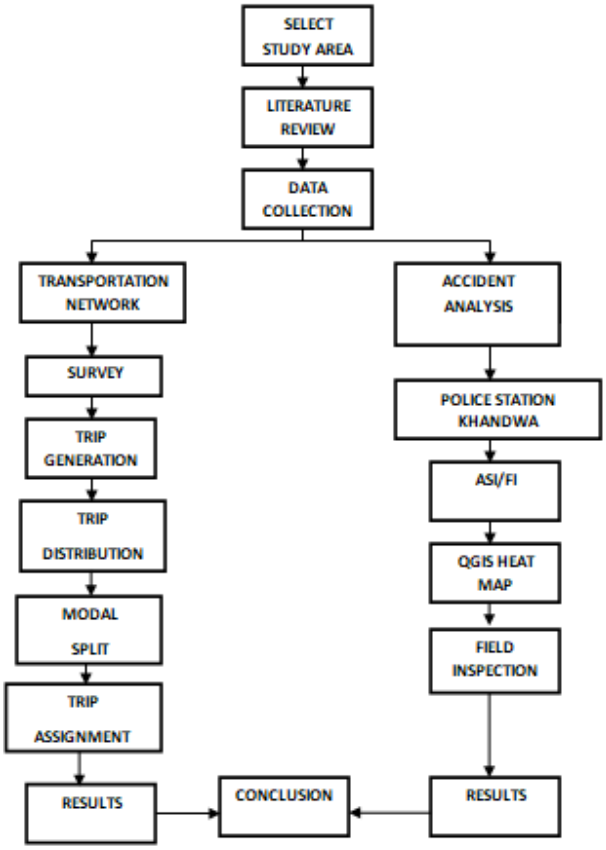


Fig. 1: Methodology Adopted

IV. SURVEYS PERFORMED

The methodology for survey adopted was home based survey and Road side survey in which questionnaire form was provided to people. For transportation network modeling vehicular count was done at peak hours. For accidental analysis data's were collected from various governmental departments such as Nagar Nigam, RTO office, statistics department Khandwa and field inspection was also done.

V. TRANSPORTATION NETWORK MODELING AND ANALYSIS

Transportation network modeling involves four stages i) Trip generation ii) Trip distribution iii) Modal split iv) Trip assignment. The study area selected for transportation network analysis is located in Nimar region Khandwa City of Madhya Pradesh. It is divided in 6 zones and 50 wards. The four transportation models are briefly discussed below:

5.1 Trip Generation: It forecasts the number of journeys that originate or end in a specific traffic analysis zone. Population of Khandwa city sourced from Nagar nigam Khandwa is 200681 and growth rate adopted for the study is 11.04%. Data have been collected from various government departments and their websites. Following results have been obtained for trip generation model which is shown in Table 1.

Table 1: Forecasted trips for production and attraction after 10 years

After 10 years		
Zone	**Productions**	**Attractions**
	Trips/per person/day	Trips/person/day
Zone 1	1033332	3047837
Zone 2	1311068	3292729
Zone 3	1175390	5695087
Zone 4	1221385	6812596
Zone 5	1003443	3828164
Zone 6	933588	2703251

5.2 Trip distribution: Generated trips from first stage are distributed in all 6 respective zones. Growth factor method has been adopted for distribution. Impedance factor involves the resistance in flow of transportation. It is given by the following equation -

Impedance factor = $e^{-\beta Cij}$ ..... (1)

Where,

β = dispersion parameter = 0.1

Cij = cost incurred while travelling from zone i to zone j

The following trip distribution model has been obtained after adjustment which is shown in Table-2.

Table 2: Adjusted trip distribution after 10 years for different zones

O/D	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	∑O
Zone 1	476690	187862	121691	108233	81595	57261	1033332
Zone 2	188709	477536	158173	297702	122538	66410	1311068
Zone 3	136041	171678	491041	202188	117585	56857	1175390
Zone 4	93590	282213	173196	462048	143437	66901	1221385

Zone 5	71672	111768	93310	148158	466767	111768	1003443
Zone 6	71982	80285	57232	96265	136412	491412	933588
∑D	801974	866417	1498553	1792593	1007356	711313	6678206
∑D'corrected	1038684	1311342	1094643	1314594	1068334	850609	

5.3 Modal split

Mode choices allow the modeler to determine what mode of transportation will be used. It is decided by utility and disutility functions. For this study 3 modes of transportation have been taken: car, Rickshaw, 2-wheeler. After the utility matrix of these 3 modes have been found out from equations (cited) probability of three modes is found out by using the following equations

$$Probability(car) = \frac{e^{Ucar}}{e^{Ucar} + e^{U2-wheeler} + e^{Urickshaw}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

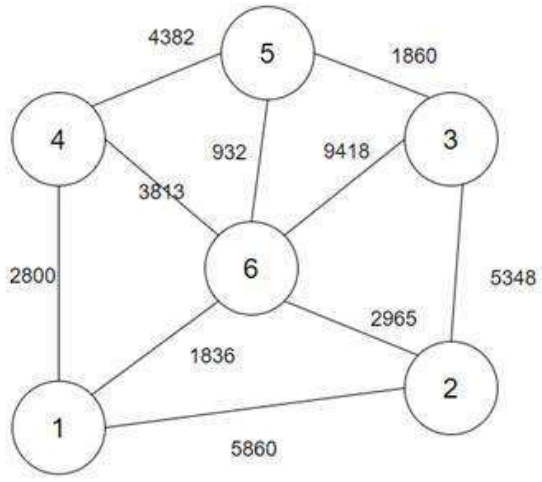
$$Probability(2-wheeler) = \frac{e^{U2-wheeler}}{e^{Ucar} + e^{U2-wheeler} + e^{Urickshaw}} \quad \ldots\ldots\ldots \quad (3)$$

$$Probability(Rickshaw) = \frac{e^{Rickshaw}}{e^{Ucar} + e^{U2-wheeler} + e^{Urickshaw}} \quad \ldots\ldots\ldots\ldots\ldots \quad (4)$$

Then using the above formulas modal share matrix for car, 2-wheeler and Rickshaws have been found out.

5.4 Trip Assignment

Here first the traffic at peak hour period have been found out. Then a network is assumed and by using generalized travel cost (GTC) for each mode of transport a matrix is prepared. Occupancy for car,2-wheeler and Rickshaw have been assumed from IRC 106: 1990 as 1,0.5 and 1.2. The final network is shown below:



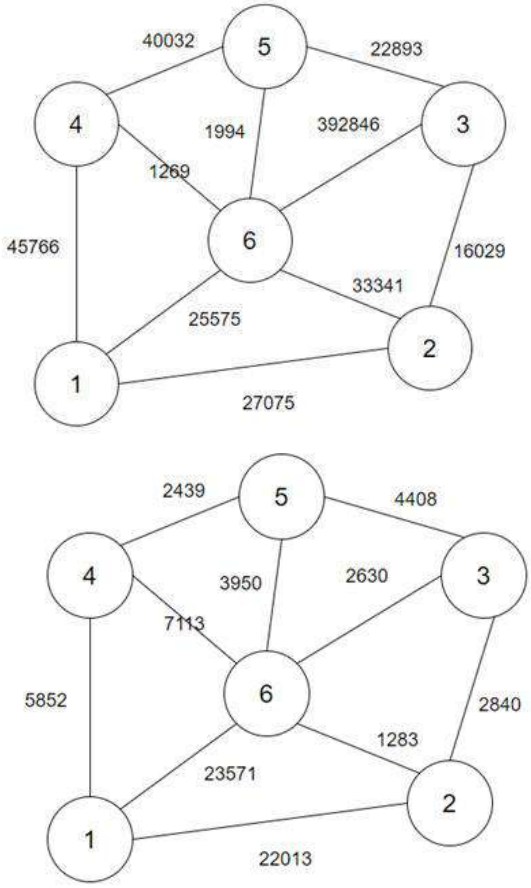


Fig. 2: Total number of cars, 2-wheeler and Rickshaw in each link

VI. ROAD ACCIDENT RESULTS AND ANALYSIS

Khandwa city has an area of 6206 square km. The roads in the city are highly congested and encroached by various activities. It is estimated that population of city will rise by 11.04% over next decade. Infrastructures have to cope up with growing population and economic activities; otherwise chances of accidental risks increases. In this study Black spot analysis of Khandwa city using QGIS software have been done. Also field inspection of those areas having higher probability of accidents have been performed.

The data has been collected from various governmental departments such as Yatayat police station, statistics departments, RTO office Khandwa.

Collected data is segregated as per weather conditions, age and type of mode of transport. The study has been grouped into 2 parts:

6.1 Black spot calculation

According to MoRTH (ministry of road transport and highways) black spot is a stretch of 500 m in length in which either 5 road accidents in all three years put together involving fatalities/ grievous injury took place during last 3 calendar years or 10 fatalities in all. Heat map using QGIS software have been found after putting the values of accidental spots obtained from Yatayat police station Khandwa and latitude and longitude of that region.

6.2 Accident severity Index (ASI)

It measures the seriousness of accidents and availability of medical facilities in the city. Based on black spot analysis ASI has been calculated as per the following equation:

$$ASI = NfWf + NsWs + NmWm \quad \ldots\ldots\ldots \quad (5)$$

Nf = Number of fatal accidents at the spot in last three years

Wf = weight assigned to fatal accidents = 6

Ns = number of serious accidents at the spot in last 3 years

Ws =weight assigned to serious accidents = 3

Nm =number of minor accidents at the spot in last 3 years

Wm = weight assigned to minor accident = 1

Table 3: Accident Severity Index

PLACE OF ACCIDENT	ASI
Rameshwar	20
Mansingh chawk	14
Main hospital	15
Girls hostel	14
SN college	11
Mata chawk	4
Awasthi chawk	6
Civil line chawk	6
Medical chawk	1
Dadaji dhuniwale	11
Sindhi colony	1

VII. CONCLUSION

1. The 4 step model processes have been illustrated for Khandwa city of Madhya Pradesh.
2. Errors in Trip generation, Trip distribution, Modal Split and Trip Assignment have been minimized through various mathematical models.
3. Transportation network model for 2031 for Cars, 2-Wheelers and Rickshaws have been calculated.
4. Since the population of Khandwa is predicted to rise by 11.04% Road accident analysis done through QGIS will be useful in taking the corrective measures.

VIII. FUTURE SCOPE

1. Improved accuracy in data collection will make transportation models more realistic and accurate. This can also be ensured by usage of artificial intelligence and machine learning tools.

2. The above transportation networks shall ensure the guidelines as prescribed. Emphasis on transportation planning at immediate stage should be given importance as much as it is provided in pre planning phase.

3. In Road accident analysis of Khandwa city black spot analysis have been performed. Accidents cause administrative, economical as well as humanitarian crisis hence while designing transportation infrastructure accidental analysis plays a key role.

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Pest Control in Agroecological Systems

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Abstract— *Agriculture changes and adds technology to increase production, the impact on ecosystems also increases, causing degradation and important losses of its main functions. These functions are represented by ecosystem services, including biological control of pests and diseases. This article aims to identify and report mechanisms triggered and responsible for the effective control of pests and diseases in an agroecological system. The pursuit of this objective took place through a bibliographic survey in databases, by subject, through the use of strings and operators to refine the searches in a previous eleven-year horizon. These searches revealed some strategies that can be used to control pests and diseases without the need for more aggressive management with the use of industrial inputs. The functionality and permanence of ecosystem services, such as pollination, nutrient cycling, microclimate regulation and increased soil fertility, depend on maintaining biodiversity in Agro-ecosystems. The adoption of such strategies by small farmers depends to a great extent on the work of Technical Assistance and Rural Extension that can promote the dissemination of the necessary knowledge for the adoption of these practices.*

I. INTRODUCTION

Perhaps the first big moment for humanity was the emergence of agriculture. From then on, man began to leave nomadism to devote himself to the domestication of plant and animal species, with the aim of producing their food. From a passive condition towards nature, exercising activities of gathering and hunting, the human species starts to develop activities that will change the landscapes.

As a producer, man experiences significant and successive improvements in his living conditions. The improvement in living conditions resulting from better and abundant food causes an increase in the world population. And the need for more and more food. This spurs agricultural activity to seek technology that will increase production and productivity to feed an ever-growing human population. This succession of discoveries and incorporation of more and more technology in the field took the world, from the mid-nineteenth century and culminating in the second half of the twentieth century, the so-called Green Revolution (Velho, Stadnik, Poltroniere, &Mondino, 2019). Mainly characterized by the energy use of industrial inputs (Vieira et al., 2020), this revolution significantly increased the production of commodities, in extensive monocultures, radically changing the relationship between man and the countryside. Ecosystems undergo profound changes to provide Agroecosystems capable of meeting the requirements of modern industrial agriculture.

Agriculture, more than a sector of economic activity, is a treaty on the relationship between man and nature. This relationship needs to be a two-way street. There needs to be a balance in the flow of this

path. Since the Green Revolution, with the advent of industrial agriculture, this balance has been undone.

Over a long period of his life Marx wrote many letters and notes that reported on his studies in areas such as biology, chemistry, agriculture, geology and mineralogy. In these, the breaking of this balance was referred to, as the need to rehabilitate the metabolism between human beings and nature in the production of food and other materials:

> This metabolism refers to the set of transformations of material exchange that occur in the complex interdependent relationships between man and nature. With the concentration of people in urban centers and large-scale agricultural production, this metabolism was disrupted and we are experiencing the consequences, especially related to environmental degradation, social exclusion and food insecurity. (Steenbock, Vezzani, Coelho, & Silva, 2020, p. 49).

As agriculture changes and adds technology to increase production, the impact on ecosystems also increases, causing degradation and important losses of their main functions.

In this process of more and more intervention in the natural environment, with the resulting loss of biodiversity, there seems to be a real *trade-off* between food production and nature preservation.

In the impossibility of making such a choice, man looks for alternatives to produce food with environmental preservation. In this case, the preservation of the environment implies the maintenance of the agroecosystem's biodiversity. To produce food and maintain biodiversity, it is necessary to understand the functioning and relationships between organisms that inhabit a given environment.

In view of the above scenario, the question that arises is which mechanisms are triggered and responsible for the effective control of pests and diseases in an agroecological system?

This article proposed, as an answer to that question, to identify and relate the mechanisms that are triggered and responsible for the effective control of pests and diseases in an agroecological system.

II. METHODOLOGY

In pursuit of this objective, a bibliographic survey was carried out in databases, by subject, through the use of *strings* and operators to refine the searches. (Pizzani, Silva, Bello, & Hayashi, 2012)

The search *strings* were obtained from the research questioning, using synonymous terms that were related in terms of content, combined through "OR" and "AND" operators. Thus, expressions such as: "pest management" AND "Agroecology" OR "agrobiodiversity" were used. At times, the return was very high, requiring some refinement. For example, when searching for the descriptor "agroecology" AND "pest management" in Google Scholar, we had the return of more than 19,000 (nineteen thousand) publications. In view of such an offer, we reduced the research horizon to the last four years. We obtained important contributions through Capes Periodicals, via institutional access using the following descriptor: "agroecology" AND "pest management". In this same portal, a search by base was carried out, using the following itinerary: Search base => by Areas of knowledge => Agricultural Sciences => subcategory => Agronomy => Bibliographic Base of Brazilian Agriculture – AGROBASE.

Searches performed outside the Capes Portal, directly on the *Web of Science* site , used the following descriptors: "agroecology" OR "pest management" OR "ecosystem services", " *pest management* " AND " *strategy* " AND " *agrobiodiversity* ", and also, " *integrated pest management* " AND " *biological control* " AND " *agrobiodiversity* ".

The longest horizon used by the above-referenced searches was 11 years, that is, from 2010 onwards. According to the return, this time was reduced, according to the situation previously reported.

The table below summarizes the databases consulted, with their respective *strings* and operators.

Table 1: Bases and descriptors

base	Descriptors
Capes Periodicals via CAFE	"agroecologia" AND "manejo de pragas"; "agroecology" AND "pest management"
Google Scholar	"agroecologia" AND "manejo de pragas" "agroecology" AND "pest management"

Web of Science	"agroecologia" OR "manejo de pragas" OR "serviços ecossistêmicos"; "*pest management* " AND "*strategy* " AND "*agrobiodiversity* "; "*integrated pest management* " AND "*biological control* " AND "*agrobiodiversity* ".

Source: Authors

Based on the problem and, consequently, on the objective of the research, and also using the descriptors defined in the bases presented, a selection of articles was carried out to be used as subsidy for the present work. This choice and exclusion process considered the relevance of the article to the research, translated into its ability to respond to the question presented. This selection was initially made by consulting the abstract, and later deepened according to its importance. The chosen ones were read in records for citation.

The figure below illustrates, in summary, all the stages of carrying out the research, as described in the previous paragraphs.

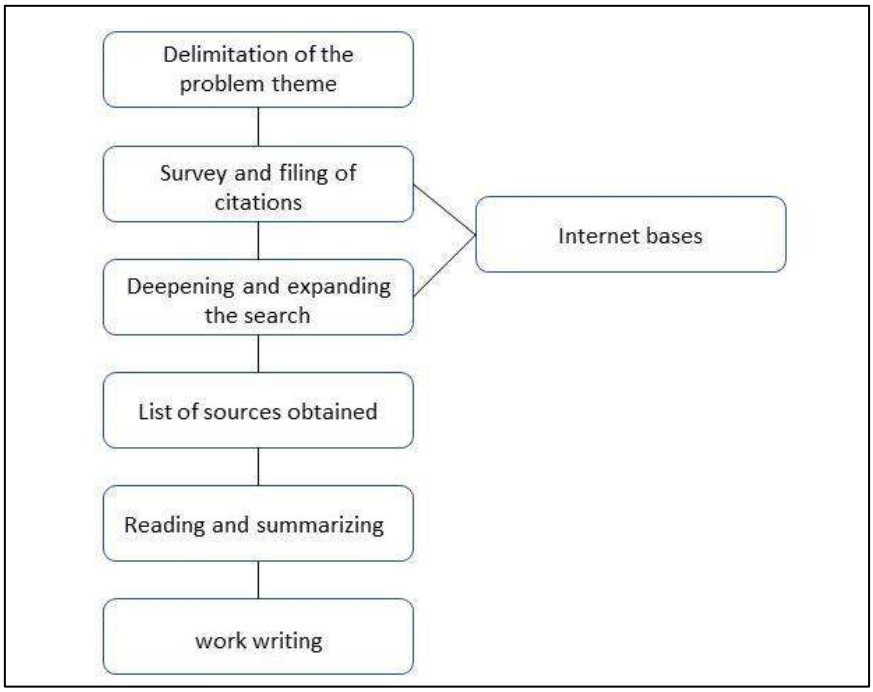

Fig.1: Stages of the literature review (adapted from Pizzani et al., 2012)

It is opportune to inform that the work did not dare to exhaust the theme, but to seek in the literature the mechanisms triggered in ecologically-based agroecosystems that have the property of maintaining control of organisms that may cause damage to crops. Given the multiplicity of relationships that can occur between organisms and the environment, it would be very pretentious for these authors to seek the exhaustion of the subject. However, the contribution presented here may support further research on a topic of fundamental importance and increasingly relevant to technological development, both in agriculture and biology and other areas of human knowledge.

III. RESULTS AND DISCUSSIONS

According to Foley et al. (2005 apud Pumariño et al., 2015) deforestation and agricultural intensification are the main causes for the loss of biodiversity and associated ecosystem services. It is known that the conventional model, based on monoculture and the intensive use of chemical inputs and heavy machinery, by promoting simplification and aggressive management of the natural ecosystem, ends up impoverishing it, interfering with its biological balance. In the future, this impoverishment promotes a loss of productivity, as more and more chemicals are used to correct imbalances to correct the soil and compensate for nutrient deficits.

In addition to these environmental and productivity aspects, the growing global awareness of the dangers exposed to human health through the use of

chemical inputs, especially insecticides to control pests and diseases, deserves special mention.

According to Pérez-Consuegra, Mirabal and Jiménez (2018), in the last 20 years the number of actions promoted by numerous organizations and institutions around the world has grown. Also according to the authors, among the most recent actions, it is worth mentioning that on the occasion of the 34th round of sessions of the Human Rights Council of the United Nations, which took place between February 27 and March 24, 2017, the Special Rapporteur on the right to Hilal Elver recommended going beyond voluntary instruments for the international community to craft a comprehensive and binding treaty that includes *developing policies to reduce pesticide use worldwide and a framework for the prohibition and phasing out of highly hazardous pesticides* .

A balanced environment provides the necessary conditions for plants to harmoniously coexist with pests and diseases, without harming crops. Thus, it is observed that in these situations:

> The plants are well adapted to the place they are living, there is sufficient quantity and quality of nutrients in the soil. It has an abundance of life, has good humidity conditions, there is an incidence of light in the system and the presence of predators and biological pests and diseases controllers. (Zanuncio et al., 2018).

This imbalance that impoverishes the Agroecosystem's biodiversity ends up leading the system to a loss of productivity.

All elements, biotic and abiotic, of an ecosystem play a role. An ecosystem in balance is one in which its components live in harmony, providing the existence of so-called ecosystem services.

For Cabral and Fukuda (2015), ecosystem services are the direct and indirect contributions of nature to the economy and human well-being, developed in a sophisticated way over millions of years. The same author also lists some of these services, such as: regular rain replacing the supply of water, CO_2 sequestration, pollination by insects and other animals, and corals and mangroves that prevent the sea from advancing on islands and continents.

The occurrence of these services depends on the diversity of organisms present in the ecosystem, in addition to a harmonization between biotic and abiotic elements. Furthermore, biodiversity is one of the basic principles of sustainable agriculture, food security and health, as well as a necessary strategy to manage systems towards sustainable Agroecosystems (Kazemi, Klug,&Kamkar, 2018). These authors further reinforce that "today, the most important challenges of modern agriculture include pest control, CO_2 emissions and genetic erosion.

In terms of agroecological control of pests and diseases, unlike what happens in conventional agriculture, the aim is to attack the causes and not the effect. The use of strategies that avoid pest attacks and the action of pathogens requires knowledge about the functioning of agroecological systems, in order to promote their diversity and balance. As stated by Zanuncio et al. (2018) the agroecological pest management seeks to promote the balance of the system, reducing the pest insect population and increasing the population of beneficial insects.

Berte Filho (2010 p. 7, apud Caetano, 2020) conceptualizes biological control as "a natural phenomenon that consists in the regulation of the number of plants and animals by natural enemies, which constitute the agents of biotic mortality".

With regard to insects, when proposing a management strategy, it is important to note that they are present in nature in order to maintain biological balance.

> Alternative management seeks to holistically observe natural cycles, respecting the interrelationships and proportions of the environment, working with systems where all factors are interdependent. (Zanuncio et al., 2018).

In an ecologically-based agricultural environment, therefore, with a high degree of biodiversity, there are a variety of ecosystem services of great importance in the production process, at least for this production model, such as pollination, nutrient cycling, microclimatic regulation and increased soil fertility. (Sugii et al, 2010, apud Venzon et al., 2019).

Also according to those authors, the functionality and permanence of ecosystem services depend on the maintenance of biodiversity in Agroecosystems. Table 2, below, presents the strategies studied by the authors for the maintenance of biodiversity.

Table 2: Biodiversity maintenance strategies

Strategy	Characteristics	Action to control pests and diseases
Agroforestry Systems	• Consortium of agricultural crops and tree species; • Microclimate moderation; • Increased water and nutrients;	• Increase the population of natural enemies; • It makes it difficult for pests to find crops; • Use plants with characteristics that favor biological pest control.
Consortium with aromatic plants	• Produce and spontaneously release repellent, deterrent or toxic organic compounds	• Attract predators and parasitoids; • Provide food and shelter; • Oviposition site and alternative prey.
Management of wild plants	• Uncultivated areas close to cultivation; • Secluded places, around and between crops.	• They attract natural enemies; • Management can increase the effectiveness of biological control.
Cover plant management	• Green fertilizers - pulses, grasses	• Improve the physical, chemical and biological characteristics of the soil; • They attract predators.
Management beyond the cultivated area	• Diversity of habitats within the property: native, varied crops, permanent, perennial, fallow, etc.	• The diversity of environments and stages of their evolution favors a greater abundance of natural enemies and greater biological control.

Source: adapted from Venzon et al.(2019).

The table above shows that pest and disease control mechanisms occur through a process of interaction between species of organisms, plants and the environment. Thus, in the structuring of a given Agroecosystem, these relationships must be deeply known, so that the result obtained is what is really expected.

A study by Togni, Venzon, Souza, Santos andSujii(2019) demonstrated a positive relationship between biodiversity conservation and the provision of biological control ecosystem services in small farms. Less aggressive and more diversified management promote the maintenance of biodiversity and more sustainable pest control.

In the case of plants specifically, they can repel, attract and even be used as traps.

For example, when cultivating cassava, the sweet potato can be used to attract the ant and thus protect the main crop. Of course, other situations must be evaluated, as usually only cassava is cultivated. In addition, sweet potato is an attraction for ants, but it is still necessary to assess what other implications may arise from this association of crops. (Marti, Küster,&Quemel, 2010).

To illustrate, Table 3 below presents some plants that can be used to protect gardens.

Table 3: Plants for the protection of vegetable gardens

Plant	control action
Basil	The smell repels flies and mosquitoes. However, it should not be planted near the rue
Garlic	Effective as a tomato pest repellent
Rosemary	Keeps away the cabbage butterfly and the carrot fly
Anise	Moth repellant
little hood	Repels nematodes and insects
citronella	It repels insects, including mosquitoes such as Aedes aegypti

Coriander	Controls aphids and mites
marigold	Protects from nematodes (attractive)
Geranium	Natural insect repellent. It's always good to have them in your garden, they beautify and protect
Sunflower	Excellent insect repellent, through its leaves and flowers and attracts pollinating insects
Mint	The smell repels Lepidoptera such as the cabbage butterfly, ants and rats. It can also be planted as a border for crops
Basil	Fly and Mosquito Repellent
masthead	Repels aphids and other insects
Sage	Repels the cabbage moth
Tagetes	Natural repellent of many insects and protects against nematodes
Thyme	Keeps the butterfly away from the cabbage
Nettle	Repels the tomato bug. Also try planting green onions, lavender and marjoram around them.

Source: Adapted from Marti, Küster and Quemel(2010).

A study by Andrade et al. (2020), with the planting of sweet potato in Sergipe concluded that Integrated Pest Management can result in a significant reduction in the use of organosynthetic insecticides with a consequent reduction in social, environmental and ecological problems, provided by the survey of the main pests and natural enemies that occur in cultivation.

IV. CONCLUSIONS

The agroecological management of pests is increasingly finding support from the consuming public, which seeks healthier food, free of chemical products, produced through environmentally sustainable and socially responsible management. In this aspect, in addition to the production process (conventional or organic) the origin of the product (local family or regional industrial) becomes relevant.

Another important aspect in the dissemination of biological pest management strategies is related to the need to popularize the knowledge of techniques among small producers, mainly. In this sense, the role of public, class and private entities to promote Technical Assistance and Rural Extension actions becomes fundamental. Universities, public authorities, especially at state and municipal levels, Unions and producer associations need to mobilize efforts to promote the dissemination of this knowledge.

Reinforcing the above aspects, as a way of showing the importance of ecosystem services, is their valuation. The incorporation of these services by the economic system can reinforce their importance and the need for preservation. When we begin to understand that the cost imposed by the loss of productivity and the time to recover degraded areas by conventional agriculture could be avoided with the ecological management of Agroecosystems, we will be able to get a sense of the value of the services provided by ecosystems in balance.

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Digitalization in Telehealth: An integrative review

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***Keywords*— computing in healthcare, patient electronic register, healthcare technologies, telehealth.**

Abstract *— The aim of this article was to identify the applicability of digitalization and digital systems within the scope of both Telehealth services and correlated remote services. An integrative literature review was utilized as methodology, and the results were classified by sections, among which: Healthcare information systems (HIS); electronic register (ER); telediagnosis; healthcare Big Data; metrics and Healthcare Technology Assessment (HTA) and digital technologies, professional capacitation & investments. Digitalization and digitalization processes in healthcare, in accordance with Big Data techniques, brought several benefits such as agility in diagnosis processes and treatment of illnesses; gathering, storage and data analysis to provide support for decision-making processes in healthcare management. When it comes to difficulties, we found the lack of investments and professional capacitation, which results in lack of quality to fill the data, as well as the lack of institutional and physical investments, therefore, we identify the opportunity and the potential offered by electronic registers to document ionizing radiation doses of patients submitted to Radiodiagnosis exams.*

I. INTRODUCTION

The development of digitalization and the incorporation of new technologies in the healthcare area have not only provoked changes, but are still shaping both the present and future relations between users (customers/patients) and services. An individual is able to virtually schedule an in-person appointment or digitally share a diagnostic image with the physician (utilizing smartphone VoIP apps, accessing desktop platforms) and the report is almost instantaneous and further added to the patient's medical records.

Regarding the influx of digital technologies in a global context, we can comprehend digital technologies in healthcare as the utilization of techniques and/or transforming processes of the relations between the users and healthcare services. The speed of the processes gives the healthcare managers an in-depth view of aspects such as epidemiology or quality markers, besides the costs involved in a given healthcare system or subsystem. However, the users are the biggest benefited by remote services, they are the ones who find the crucial information necessary to individually or collectively take care of their health, because the access is agile and easy.

The utilization of CITs (Communication and Information Technologies), more precisely, the digitalization associated to the development of the Internet, which acts as an intermediary to implement and apply such technologies, made possible the surfacing and constant development of a new way of providing healthcare, both by means of innovations in therapeutic areas (personal medicine, biomedicine, etc.) and digital practices (digital therapy, based telehealth and mobile devices (Sandoval, Giangreco, Gómez, González & Dalub, 2017; WHO, 2020a).

In 2000, the Information Society Program (SocInfo) was unveiled in Brazil with the goal of tracking the foundations to integrate development and applicability of CITs in favor of decreasing social inequalities, increasing social inclusion and democratic access to information. Back in the day, the information society was seen as a new socio-technical paradigm expected to transform all the sectors of the society, promote innovation, increase social participation and

strengthen the Brazilian culture with an emphasis on cultural diversity (Takahashi, 2000).

Three pillars supported the transformation proposed by SocInfo, among which stood out: the technological base convergence, possible through the digitalization of data and the sharing of images, videos, texts, etc., called "content"; the industry dynamics that made electronic equipment more affordable and the global growth of the Internet, which was much bigger, as opposed to other media channels, such as TV and radio (Takahashi, 2000).

Within the technological and digital scope, changes are not static. 21 years after SocInfo was launched, we face a new paradigm, the digital transformation one (Rogers, 2020), which not only consolidates many expectations of that time, but also designs the profile of social relations on medium and long terms, with an emphasis on businesses and services, in a continuous spiraling development process that impacts all sectors.

The set of healthcare services offered by digital means is known as Telehealth. The WHO describes the concept as:

> [...] delivery of health care services, where patients and providers are separated by distance. Telehealth uses ICT for the exchange of information for the diagnosis and treatment of diseases and injuries, research and evaluation, and for the continuing education of health professionals. Telehealth can contribute to achieve universal health coverage by improving access for patients to quality, cost-effective, health services wherever they may be. It is particularly valuable for those in remote areas, vulnerable groups and ageing populations (WHO, 2009b).

According to a WHO's research from 2016, 50% of the nations that were part of a global survey do have a national telehealth policy (WHO, 2016f). According to the Brazilian Federal Council of Medicine (CFM number 2.227, of December 13, 2018), telehealth is defined as "the exercise of Medicine through the utilization of interactive methodologies of audiovisual communication and data, with the goal of provide assistance, education and research in healthcare." Rahimi, Nadri, Afshar & Timpka (2018) identified the three main areas that utilize CITs in healthcare as: telemedicine, electronic registers and mobile applications.

Within this scenario, we're able to find: a) Medical digitalization, characterized by the application of different technologies such as the EHR (Electronic Health Records); b) the telemedicine, which involves the sharing of information between doctors-doctors and doctors-patients, which should be mentioned branches such as teleradiology, telepathology, telesurgery, among others; c) the medical-oriented social media such as MyBubble and FENAM NETWORK, besides medical communities such as Medical Dignity (Facebook) (de Camargo & Ito, 2012).

Telemedicine works through a digital ecosystem that comprises software, platforms, devices, internet, computers, smartphones, etc., which enable healthcare services to reach both the local and the most isolated and hardest to access communities. Highlights for the services of: a) tele-appointments, in which the patient is served by professionals and experts in various areas; b) assistance, such as remote monitoring of a patient (telemonitoring), issuing diagnostic reports of radiological imagery (teleradiology); and c) education that favors capacitation and sharing of information between professionals (Rahimi et al., 2018; Morsch, 2019).

This is the area of greatest interest in the field of TAM applications research, with large acceptance by doctors and nurses. Some of the most common factors that justify the applications of TAM are self-efficiency, experience, training, compatibility and habit, which can serve as base models for most technologies in a logical context (Rahimi et al., 2018).

As for teleradiology, according to the WHO (2009b) it's the most consolidated medical modality in the landscape of remote services. For Bashshur R. L., Krupinski, Thrall, Bashshur N. (2016), teleradiology is a medical modality that allows the acquisition, processing and sharing of images through a digital system via Internet.

For this work, regarding the initial research concerning digitalization in healthcare, some of the points observed in the literature were: the importance of the Healthcare System Information (HSI) as a whole (Galdino, Azevedo, Tenorio, Teixeira, Medeiros, Costa & Dantas, 2016; Rover, 2008); the possibility of evaluation metrics (de Alkimim, Parreiras, Santos, Reis & Muylder, 2016; Schall, Cullen, Pennathur, Chen, Burrell & Matthews, 2017); the monitoring of results (Fernandes & Tareco, 2016); the support of Information Management (Galdino et al., 2016; de Souza, Borges & Fernandes-Sobrinho, 2020); the patient's integral care (Pissaia, da Costa, Moreschi, Rempel, Carreno & Granada, 2018); the data standardization and questions related to patient's data safety (da Costa & Linch, 2020); the utilization of smartphones, tablets and apps such as WhatsApp (Sandoval et al., 2017).

The aim of this work was to understand the relationship between digitalization and healthcare, identify correlated studies and the viability of researches over patient's electronic register and healthcare Big Data and categorize the applicability of computing in healthcare, with an emphasis on remote services, in order to point out topics of interest for computing research in healthcare.

For that, we sought to answer the following questions: 1) What are the benefits of digitalization when it comes to

developing the healthcare area? 2) What are the examples of digitalization applicability in a healthcare system? 3) What are the implications and barriers to implement computerized services in healthcare? The results were grouped by similarity and then, it was introduced a discussion about the findings.

II. BACKGROUND

The development of the medical area had and still has a direct impact over the increase of life expectance, quality of life and the decrease of child mortality. About 80% of the medical area data are images, whereas the other 20% are originated from data that comes from documents and texts (de Freitas & de Souza Poletto, 2019). Such development has been supported and potentiated by the healthcare digitalization, mainly regarding the management and sharing of data and patients' clinical data.

Citizen's data that goes through the Healthcare Information System (HIS) characterize them as fragmented personas whose information are scattered throughout several systems that in many cases don't communicate with each other, which can confuse the trackability and integrity of the data that concerns a given citizen (Moraes & Gómez, 2007).

However, digitalization and sharing of data bring speed to processes that involve attention, promotion and information in healthcare. By means of connecting and interconnecting information, because of system's integration and interoperability, is possible that a decentralizing healthcare system, such as Brazil's Unified Healthcare System (SUS), could have centralized data, services convergence, epidemiological mapping, among other possibilities.

Information and Communication Technologies (ICTs) present a crucial role in the implementation of new relations in the current society, focusing more and more on social inclusion. There is a major advancement of emerging technologies in healthcare, such as business intelligence (BI), digital certification and Electronic Health Records (EHR) (Roberto, Costa & Puga, 2019).

The utilization of Information and Communication Technologies (ICTs) in healthcare is known as e-Health (WHO, 2021c). The utilization of computers and software is beyond the data organization, data structure and the healthcare information are building a new culture and new relations between the citizens and the healthcare systems.

The 71st World Healthcare Assembly (WHA), which took place in 2018, discussed the Resolution WHA71.7 for developing digital healthcare among those member states, pointing out the topics that involve a development by means of a digital healthcare (WHO, 2019d; WHO, 2018g). According to (WHO, 2019d), investments in this area can contribute to the reduction of health inequalities:

> Linking digital investment to public health and health promotion and disease prevention goals requires strategic approaches and organizational changes based on identified needs. Without such approaches, the digitalization of health systems risks introducing new or increasing existing health inequalities – creating divides where resources are not aligned with social needs and where the benefits do not reach the most vulnerable people (WHO, 2019d, p.2).

The WHA71.7 brought important appointments concerning digital technologies and their role alongside healthcare strategies to promote health, prevent illnesses and provide sustainability and innovation in all member states. It became evident the healthcare model focused on citizens with an emphasis on interconnection between different digital technologies (WHO, 2018g).

Some recommendations for the member states, regarding digital technologies, include: the access to digital systems at different levels; the way of integrating previously different systems; and the interoperability and better data treatment between citizens, healthcare professionals and the government; and better cost-benefit, with the goal of establishing an inclusive healthcare model accessible to everybody (WHO, 2018g).

Smartphones also have an important role for everybody involved in healthcare processes: the professionals, the institutions and the citizens. Mobile technologies promote the ubiquity of services and instant access to the information. The designed term referring to the utilization of mobile technologies in e-healthcare strategies was described by the WHA71 as mHealth (mobile health) (WHO, 2017e).

The WHO (2016f) recognizes the global role of digital technologies in healthcare systems, because of their capability to manage data across different areas; register and personal monitoring of patients; non-communicable risk factors' trackability, alcoholism and sedentary lifestyle; follow-up of patients with chronic diseases such as diabetes, cardiovascular conditions and cancer and increase the overall health safety, besides improving the engagement among people.

Since the beginning of the Covid-19 pandemic, announced by the WHO in March 13, 2020 (WHO, 2020a), there has been an accelerated follow-up of the digital transformation, adaptation and innovation of companies and their services in different segments, something that was already happening (Rogers, 2020). This accelerated process has been possible because of the level of technological development and the engagement we have witnessed among

people, which has brought several benefits for healthcare in a global scale.

According to decree number 2.546, of October 27, 2011 (Art. 12, § 1º), Telehealth "is the autonomous establishment that utilizes information and communication technologies to perform assistance and education in healthcare, across geographic and temporal distances". Some of the services described by Novoa & Netto (2019) include Telemedicine, Telereport and Telepharmacy.

In 2010, the Brazil Telehealth Program was implemented by decree number 402, of February 24, 2010, which revoked decree number 35, of January 4, 2007, and was further enlarged into Brazil Telehealth Networks, by decree number 2.546, of October 27, 2011.

The national program Brazil Telehealth Networks deals with the structure and organization of services such as tele-education, teleconsulting, telediagnostic and Formative Second Opinion, a service of scientific answers for questions originated from teleconsulting. It also defines the safety standards for managing the data of the Electronic Healthcare Record (EHR) and interoperability criteria between the Program and other SUS systems.

Two historic moments pointed out by Zundel (1996) as telemedicine milestones are: the utilization of the telephone in 1900 and 1930, for medical communication with remote areas of Australia and Alaska and the introduction of television in the 50s, which allowed the sharing of imagery and results of lab exams.

Telemedicine is a modality that surfaced thanks to the development of communication tools, transforming the relationship between healthcare services and customers/patients. Through telemedicine is possible to perform treatment, prescriptions, appointments and continuous professional education. Thus, the need of a faster service was contemplated and the geographic distance between physicians and patients was shortened (Wurm, Hofmann-Wellenhof, Wurm R., Soyer, 2008).

The definition of telemedicine in Brazil, as well as similar services such as tele-appointments, telemonitoring, telesurgery, among others, was defined by the Federal Council of Medicine (CFM) with decree number 2.227/2018, although it was revoked by decree number 2.228/2019 because of the amount of suggestions proposed by doctors.

That's probably because of the endless possibilities of innovation and creativity through the utilization of technologies for healthcare application, which may cause the lack of consensus regarding standardization. Meanwhile, during the Covid-19 pandemic, the utilization of Telemedicine has been endorsed by law number 13.989, of April 15, 2020.

One of the medical branches that already stood out in a digital ecosystem is Teleradiology. Through a system named PACS is possible to share diagnostic imagery in a specific format named (DICOM) in various modalities such as CT scans, X-ray (DR and CR), MRI scans among others.

Sharing this imagery speeds up the issuance of physician's reports, thus contributing to the process of hospital admission, interventions and early treatment of diseases, cost reduction with unnecessary admissions to hospital environments and medical diagnostics for people in remote regions (Bashshur et al., 2016).

The term e-health is utilized to express the utilization of information and communication technologies in the healthcare area. Its actions can contribute to the organization, agility and availability of information flow, thus contributing to managing and governing processes, and even in processes of professional education (Eysenbach, 2001; Ministério da Saúde, 2017).

Besides the data convergence, the interoperability and integration of systems points out to the fact that the utilization of digitalization in healthcare plays a role that is both intermediary, as it gives support to information paths and relations between users and services, and similar to a driving force, as long as the computing development and innovation propels the healthcare up to higher levels (Ministério da Saúde, 2017).

The e-health system in Brazil comes to provide support to the National Healthcare Program (NHP) and to the SUS principles. Among the benefits offered by the e-health that stands out the most, we highlight the patient's instant access to appointments and medications, appointment schedules and remote appointments. The e-health structure aims to strengthen intersectoral strategies for a decentralized governance, a SUS characteristic, as well as to build initiatives, align actions, promote a tight relationship between research, innovation and health, create standards and certifications, among others (Ministério da Saúde, 2017).

The importance of the e-health is also oriented towards social development, as long as it allows an aperture for technological innovation and further job opportunities (Ministério da Saúde, 2017). This has also been witnessed in areas of digital commerce, which created initiatives during the Covid-19 pandemic that are considered crucial to businesses survival.

III. METHOD

In order to gather material from the database, it was initially performed an in-depth search in the CAPES/MEC Periodic Portal, with the goal of identifying the structure of digital systems in overall Healthcare, with an emphasis on overall telehealth modalities and treatment of patients data,

followed by a research in the Virtual Health Library (VHL), in which we selected articles from LILACS and MEDLINE database, aiming to locate those works addressing documentation or register of doses through technologies or digital systems. Next, we searched in the Scientific Electronic Library Online (SciELO), by repeating the query goals and criteria utilized in the VHL research.

The advanced search in the CAPES/MEC Periodic Portal utilized the following query strategy: it must keep the keywords "teleradiology" or "digitalization in healthcare" in any part of the work; it must have been published over the past 5 years (2016 a 2020); the type of material must be "articles", excluding books, sites or any other source; it must have been written in any language, but it must select only those in Portuguese, English, Spanish or French; it must be reviewed by pairs, which resulted in 14 items related to healthcare systems and 02 items related to applications, out of 795 found items.

Besides the aforementioned content, we sought as content inclusion criteria, those works with an emphasis on subjects such as: electronic register documentation; healthcare information digital systems; teleradiology. We excluded those works that had an emphasis on educational processes or any other topic that diverged from the inclusion criteria and addressed only applications, essays, duplicate articles, dissertations and thesis, regardless whether they had the aforementioned search keywords.

The works were selected according to their titles and then the summaries were read in order to select those which adhered to the inclusion criteria. A total of 14 works were selected and presented in a framework in the results section, those being classified in reviewing and original articles.

As for the VHL search, we utilized the following keywords in the query strategy: (telerradiologia) OR (teleradiology) OR (teleradiología) OR (téleradiologie) OR (coordenador clínico de telessaúde) OR (clinical telehealth coordinator) OR (coordinador clínico de telesalud) OR (coordonnateur clinique de télésanté) OR (aplicações de informática médica) OR (medical informatics applications) OR (aplicaciones de la informática médica) OR (applications de l'informatique médicale). All the above described were characterized on DeCS (Descriptors in Health Sciences) of BIREME.

The following filters were applied: Database: MEDLINE & LILACS; Main Subject: Medical Computing Applications, Medical Computing & Teleradiology; Type of Study: Economical Evaluation in Healthcare, Systematic Reviewing, Evidence Synthesis and Healthcare Technology Assessment; Language: Portuguese, English, Spanish & French; publishing interval from 2016 to 2020.

After we applied the filters, the query returned 59 articles. The same inclusion and exclusion criteria of the research conducted in the CAPES/MEC Periodic Portal were here applied. A total of 5 articles were selected and presented in a framework in the Results section, those being classified in reviewing and original articles.

As for the SciELO research, we utilized the same keywords utilized in the VHL research and applied the following filters: Collections: All; Periodic: All; Language: All; Year of Publishing: from 2016 to 2020; SciELO theme areas: Health Sciences; WoS Theme Areas: Healthcare Sciences & Services, Medical Computing, Politics and Healthcare services and Medical Laboratorial Technology; Type of literature: Article and Reviewing article.

After the application of filters, the research returned 17 articles. The same inclusion and exclusion criteria of the research conducted in the CAPES/MEC Periodic Portal, were here applied. A total of 03 articles were selected and presented in a framework in the Results section, those being classified in reviewing articles and original articles.

After applying the procedures to select the articles, these were fully read for data gathering. On this step, 01 out of 22 resulting articles were excluded over their low or almost nonexistent adherence to the subject of study, resulting in a final sample of 21 articles. After evaluation and critical readout of the works, the data necessary to build the text body was gathered, analyzed and interpreted.

Although it concerns an integrative review, the steps utilized to analyze the literature were based on Cochrane's systematic reviewing procedures, which are synthesized in: 1st) Question formulation; 2nd) Methods planning; 3rd) Protocol redaction and publishing (does not apply); 4th) Research developing; 5th) Search execution – localization and selection of database studies – the data gathering took place between the months of Jan. and Mar. 2021; 6th) Studies selection; 7th) Data gathering; 8th) Bias risk analysis; 9th) Data analysis; 10th) Interpretation of the findings.

IV. SELECTED WORKS

Next, we presented a synthesis of the selected works, in which the main goals and findings are described and grouped by database.

CAPES/MEC Periodic Portal

De Alkimim (2016) presented a review of the studies that involved Electronic Healthcare Record (EHR), Metrics for Objects Orientation (OO) and openEHR. There was an increase of publishing by 2008, with openEHR applicability. Local: Europe.

Fernandes & Tareco (2016) reviewed the Systems of Healthcare Information (SHI) and identified both the pros and cons of SHI in nursing, besides evaluating its applicability as a quality marker. SHIs comprise the

foundations of practical and clinical decisions, thus improving the healthcare process. Local: unavailable.

Galdino et al. (2016) sought to understand the research scenario regarding information management in the SUS, the importance of SHIs and issues like software malfunction and lack of personnel capacitation. Local: Brazil.

De la Escalera & de Azcarate (2018) reviewed the relations of Europe's public healthcare system and information management, besides Big Data contributions to this subject. A Big Data must become the foundation for analysis and planning in healthcare systems, thus contributing to effective changes in healthcare systems. Local: Europe.

Santos, Pereira & Silveira (2017) analyzed a SHI and the data with management support. The SHI can contribute to assertive decision-making processes in healthcare, but for that to happen, there's no need to standardize terminologies and feed correct data into the system. Local: Brazil, USA and Europe.

Pissaia et al. (2018) studied Nursing Care Systematization (NCS), in order to identify the impact of the implementation of Computing Systems in nursing services. It was identified the safety of healthcare management supported by SHIs. Local: Brazil.

Carrasco & Medina (2019) reviewed the digitalization in healthcare. There was a comprehension of the relations between healthcare workers and healthcare systems, and the SIGGES was pointed as a data centralizing technology. Local: Chile.

Da Costa & Linch (2020) studied Nursing Care Systematization (NCS) and electronic registers, which are present in different healthcare branches such as telehealth, clinical decision systems, among others, and there's a need to standardize the language in nursing. Sites: USA, Australia, South Korea, Switzerland, Finland, Argentina, Slovenia, Netherlands, Canada, Thailand, Brazil, Norway and Germany.

Alves, Kuroishi & Mandrá (2016) sought to identify the printing of the Patient's Electronic Health Record (EHR) in Speech Therapy. The EHR is a more efficient tool than conventional methods, when it comes to provide services of low/average complexity.

Gava, Ferreira, Palhares & Mota (2016) aimed to understand the experience of implementing the National Healthcare Card (NHC). The digitalization brought improvements for the service and widened the capability of healthcare management, which changed the reality of healthcare in a certain manner. Local: 44 cities, highlights for Aracaju City, SE, Brazil.

Galván et al. (2017) established the viability of a telediagnostic system for isolated populations in Paraguay. The practical application of telediagnostic not only strengthened the access to healthcare services, but also allowed an equal distribution with cost reduction. Local: Paraguay.

Lima, de Brito & de Andrade (2019) conducted a comparative study of Conitec with Australia, Canada and United Kingdom. They found differences of structure, technology analysis and program evaluation, making evident that Brazil still needs a continuous optimization. Sites: Brazil, Australia, Canada and United Kingdom.

Silva, Guedes, Síndico, Vieira & Andrade (2019) outlined the contributions of digitalization in healthcare. The electronic register (ER) becomes a crucial document to organize a healthcare system, regardless the isolated initiatives that cause the fragmentation of the SUS. Site: unavailable.

De Souza et al. (2020) understand the role of software in Simplified Data Gathering (SDG) and the role of the Citizen's Electronic Health Record (EHR) to integrate the healthcare service. Software are innovations whose implementation is gradual. The main limiting factors are related to the lack of technological structure and professional capacitation. Site: Goias, GO, Brazil.

Virtual Healthcare Library

Pashazadeh & Navimipour (2018) introduced the state-of-the-art, through a systematic reviewing regarding Big Data applied to healthcare in five categories, whose results point to positive benefits for behavioral change and decision-making processes to elaborate healthcare policies. Site: unavailable.

Rahimi et al. (2018) reviewed publications about Technology Acceptance Model (TAM) concerning the development of healthcare systems. The three main areas that utilize ICTs in healthcare are: Telemedicine, Electronic Registers and Mobile Applications. The application of different technologies in healthcare comprises a field of research in expansion. Sites: USA, Europe, Asia and Africa.

Neame, Chacko, Surace, Sinha & Hawcutt (2019) identified the main interventions of Information Technologies in healthcare (Health Information Technology, HIT). The main benefits identified by the application of Information Technologies in healthcare were: support to clinical decisions, Electronic Registers and digital data input.

Bashshur et al. (2016) documents the fundamentals of teleradiology that allows to acquire, broadcast and manipulate imagery, corroborating the radiologist's diagnosis with agility and assertiveness.

Schall et al. (2017) describes the process of developing and implementing a control panel to promote basecare based on evidence.

SciELO: articles for review

Sandoval et al. (2017) identifies the preference for ICTs among resident doctors in General Surgery. Users rather utilizing smartphones (97%), notebooks (34%) and tablets (20%). A study demonstrated the positive interest regarding the utilization of ICTs for education. Site: Paraguay.

Essop & Kekana (2020) sought to understand the experiences and identify the impacts of teleradiology over the local context, and they realized how radiologist doctors were extending the functions beyond the expected by the teleradiology service, and how the training of radiologist doctors was imperative, so that they were able to comprehend the actual challenges posed at countryside areas, thus seeking a bigger alignment with the local needs.

V. THEMATIC GROUPS

Next, we present the selected works grouped in the following categories: Healthcare Information Systems (HIS), Electronic Registers (ER), Telediagnostic, Big Data in Healthcare, Software, Metrics, Healthcare Technology Assessment (HTA) and Digital Technologies, Professional Capacitation & Investments.

Healthcare Information Systems (HIS)

Fernandes & Tareco (2016) considered how Information Systems (IS) in nursing, comprise an important support instrument concerning the quality of information in healthcare environments. They also contribute to decrease mistakes and increase agility in the processes to obtain clinical and gestational data, besides reducing the data disproportion. As far as IS limitations go, the authors made explicit the need of technological knowledge and the importance of a proactive professional profile.

The authors delimited 3 levels of content in their research. The first level deals with management and operation, the second level deals with evaluation, audit and register of the patient and the third level deals with markers and decisions. The agility, safety and trackability of the data were evident, with positive impacts over the service quality and productivity through electronic registers, besides the importance of data documentation concerning management decision-making processes. On a negative note, highlights for the funding as a necessary requirement to execute an IS.

Galdino et al. (2016) divided the research results in two categories: the first one was Systems Functioning and Importance, whose aspects considered to be positive were: support to attention and promotion of healthcare; support to decisions and planning, development of a participative institutional culture; besides the storage of data for further analysis, with an emphasis on nursing and attainment of informative reports.

The second category outlined by Galdino et al. (2016) presented the Systems Problems, in which the main difficulties were: low quality or absence of data input; internal communication noise; low professional capacitation; lack of supervision over the data input process and lack of technological evaluation.

Santos et al. (2017) concluded how the HIS is important when it comes to make assertive decisions in healthcare and how it's necessary to feed data into the system with the biggest precision possible. The authors categorized the information in 4 distinct points that involve aspects such as management and difficult to implement a HIS.

For them, quality, synthesis or integration of patient data are crucial for the management and epidemiologic control in healthcare. The utilization of computing and networks enable the admission to a healthcare service, as well as the control of adhesion to medical treatments, allowing a general panoramic view of an individual's overall health state, as well as the efficiency of the approached clinical strategies.

Still according to Santos et al. (2017), regarding the implementation of HIS, the difficulties pointed by them were ruled by the lack of terminologies standardization and systematic data collection, adding up to the extra work that can occur in the computing processes, such as inputting data into the system. Besides, there's a lack of cohesion between the initiatives for utilization of digital technologies, which tend to meet local expectations and demands. That could disturb or prevent a technological plan within a national scope.

For da Costa & Linch (2020), the digitalization of healthcare processes is currently a rule, so as to give the utilization of digital technologies a much bigger role than simply replacing the documents that once were filed in paper sheets, thus allowing a panoramic and agile view of the usability issues and relations between users and healthcare services.

According to them, although there are countless seeming benefits, some institutions present problems in the processes that involve data imprecision and conflict of institutional interests, besides those questions related to hardware and software. Another point would be the need of a leadership capable to keep up the quality of data input in the registers, as well as the standardization of procedures, in order to create a useful database with as less mistakes as possible, which could have an impact over the whole management chain and clinical decision-making processes.

Gava et al. (2016) conducted a comparative study through a quiz, concerning healthcare systems, and described the process of implementation and analysis of the National Healthcare Card (NHC). One of the quizzes involved a non-computerized system (n=40), whereas the other addressed the digitalization of the same system (n=56).

The main changes identified after the implementation of a computerized system, took place in the physical realm,

such as the replacement of paper sheets for digital data, changes in the physical environment (furniture, physical space, etc.), having an impact over the whole work. The digitalization and the access to digital data promoted the digital inclusion of professionals, regardless of the necessary time to adapt to the system, streamlined the researches and provided a greater security to the patients' data, as long as there is no longer the possibility of misplaced papers.

On the other hand, the authors identified the difficult with codes and excessive information to be filled, which increased the appointment times, as long as the doctor spent more time to fill technical information necessary for registration. Despite the difficulties, the benefits of obtaining statistic data, both individual and collective, were evident.

The main benefits reported by Gava et al. (2016) regarding the utilization of the National Healthcare Card (NHC) were: the ease of patient data recovery (100%), the standardization of data and information (97,4%), the support to referral schedules (87,5%), the decrease of manuscript work (85%) and the ease to provide diagnostic, treatment and make decisions (75%).

Pissaia et al. (2018) analyzed the way the Nursing Care Systematization (NCS) would be influenced by computing technologies. The authors outlined four crucial points concerning the implementation of NCS, among which: 1) work methodology; 2) intermediation of information technology tools; 3) support tools for multi-professional teams; and 4) facilitation of healthcare service management processes.

They identified how the digitalized processes and digital technologies contribute to integral academic formation, to develop critical-thinking skills in the work environment due to the ease of correlating nursing data and prescriptions. They also pointed out an improvement in the relations between multidisciplinary teams and improvements in management with a direct impact over decision-making processes.

Carrasco & Medina (2019) analyzed the Sistema de Información de Gestión de Garantías Explicitas en Salud (SIGGES), in Chile. According to the authors, the system is characterized a mixed system in which state and private funds virtually integrate. It enables the monitoring of how the citizens are benefited by the healthcare system in accordance to their rights, taking in account aspects like medical appointments and reports.

The SIGGES is manually fed by different healthcare professionals who manually fill the "Formularios de Constancia de Información al Paciente GES" (Article 24th, Ley 19.966) (Carrasco & Medina, 2019 , p.8). They serve the purpose of registering the users' accesses to healthcare services and billing tools as well.

Still according to Carrasco & Medina (2019), among the difficulties to implement a healthcare reform in Chile, both the economic and organizational/administrative factors are directly related to capacitation and position attributions concerning professionals who were supposed to perform activities that feed the SIGGES databank. A counterpoint is that the SIGGES renders countryside areas invisible, because of the lack of access to computers or networks in those regions.

Pashazadeh & Navimipour (2018) take into account that there isn't a single system capable to embrace all the questions that are relevant to healthcare management processes. For them, the HIS needs to be a compound system in order to serve a vast demand for offers and services, and it would be nearly impossible to develop a single system capable to meet all the healthcare needs.

Electronic Registers (ER)

Schall et al. (2017) reported the development, evaluation and implementation of a control panel for healthcare registering, based on healthcare information technologies. The authors came to conclude that the tool could improve the speed and precision of clinical decisions. In order to keep the results in a positive and assertive manner, the authors took into account the need of having a visual order in the panel structure.

In a SWOT analysis concerning the implementation of a healthcare electronic register, (Silva et al., 2019, p. 1136) demonstrated how it could have an impact on the work practice and contribute to standardize the information. On the other hand, the absence of an internal structure could contribute to the non-adhesion of other strategic sectors, thus causing divergences, moreover, the system could face interoperability difficulties regarding other systems, such as the E-SUS AB and Hospitalar, for instance.

Regarding the importance of Electronic Health Record (EHR) for speech therapists, Santos et al. (2017) indicated as positive points: organization and dynamism; bigger efficiency as opposed to physical health records; easy-handling and quick adaptation to the system; decrease of waiting times. The main data is that for group 1 (82,22%) and group 2 (100%), the EHR makes the clinical service easier and promotes overall benefits for users and professionals.

For Pashazadeh & Navimipour (2018), electronic registers can be stored in different formats with a high level of security for patients, but it is necessary a high level of management of the method. Furthermore, heuristic and meta-heuristic mechanisms are utilized in order to optimize solutions with high performance and service quality,

besides the fact that they stand out as more affordable methods.

The main benefits identified by Neame et al. (2019) regarding the application of electronic registers within the realm of healthcare information technologies were: support to clinical decision (Clinical Decision Support CDS), through the patients clinical analysis for evidence-based interventions; automation of processes through patients data organization; organization among systems; patients treatment order; medical conduct analysis on a case-by-case basis; access to information such as documents, guidelines and patients reports.

Silva et al. (2019) reported the difficulties to implement an electronic register system and the lack of both material and human resources. The insufficient infrastructure may comprise the lack of high-speed Internet, lack of equipment such as computers, certifications and normative requirements. On the other hand, there could be difficulties with under skilled labor or people unwilling to handle new tools and systems, which could cause failures in the administrative processes.

Another difficult, pointed out by Silva et al. (2019), regards the need of multidisciplinary service schedules, although the system points to a single register number for each patient, which makes the processes less fluid, thus causing extra work.

Telediagnostic

Rahimi et al. (2018) state that Telemedicine has been one of the greatest subjects of research in the TAM field. According to them, there is a major acceptance by doctors and nurses, due to the countless benefits of its applications, among which: self-efficiency; experience; training, compatibility and habit that could serve as a base model for most technologies in a logical context (Rahimi et al., 2018).

Bashshur et al. (2016) described the following benefits of Digital Radiology as opposed to Conventional Radiology: improvement in imagery quality; more assertive interpretations; decrease of patients transfers, mainly in rural areas; less need of re-exposing patients to X-rays, which makes for less doses; detection of large number of pathologies; cancer screening and early diagnosis; remote monitoring of stent patients and total cost reduction.

Galván et al. (2017) reported the implementation of a telediagnostic electronic system in Paraguay, based in open-source software and comprising three main modalities: Echography, Computerized Tomography (CT) and Electrocardiogram (ECG). The imagery was streamed through the Internet, for analysis and report issuance (Telelaudo) by the radiologists in charge.

The authors' cost-effectiveness analysis highlighted a reduction of costs in the remote modality. Case in point: patients bearing transportation costs to take themselves to wherever exams are done, or to go to the doctor in order to receive their report or even costs with food. This study addressed isolated populations of Paraguay, people who would certainly have elevate costs in order to travel to the capitol Asunción, for instance.

The three modalities researched by Galván et al. (2017) are: Echography (19 studies), ECG (21.111 studies) and CT (12.966 studies) constitute a golden standard in the medical diagnosis. The implementation of the system benefited 1.497.725 inhabitants distributed among 25 communities with identifiable hospitals and 6.503.976 inhabitants in areas influenced by hospitals, which represented a coverage of 92,7% of the nation's total population.

Big Data in healthcare

The systematic reviewing of Pashazadeh & Navimipour (2018) contributes to build fundamental aspects that involve Big Data within the healthcare scope. The authors classified the study results in five categories, among which: Machine learning-based, Agent-based, Cloud-based, Heuristic-based and Hybrid-based. They highlighted how artificial intelligence-based machine-learning for data treatment can bring high performance for healthcare management and medical care.

De la Escalera & de Azcarate (2018) pointed out interoperability as the main contribution of Big Data for healthcare services. That's because the data is organized and converted in practical actions in clinics and overall healthcare, oriented for decision-making processes in various realms. As a pre-requirement, the authors pointed out the need of a high-performance infrastructure network involving hardware and software.

Still according to the authors, it's necessary to overcome ethical and legal barriers, when it comes to handling patients' data. Furthermore, the efficient implementation of Big Data in a healthcare system is supposed to be attached to its capability of adding value and benefits to the patients, institutions and healthcare professionals. For that, it's firstly necessary to know the needs and problems to be solved through Big Data, thus being able to make a correct decision to implement digitalized systems in healthcare environments.

Software

De Souza et al. (2020) conducted a qualitative study of applied nature in order to understand the process to implement the free software CDS and PEC, in a tiny Brazilian town located in the state of GO. According to the authors, the CDS has a multidisciplinary dynamic, thus being utilized by different healthcare professionals and the data can be inputted offline, whereas the PEC enables online data input and the data is streamed directly to the Healthcare and Basecare Information System (HBISYS).

Concerning the software importance for managing the information in local healthcare, de Souza et al. (2020) identified how they contribute to organize healthcare unities, reduce the waste of paper, optimize the workflow and allow the trackability of a patient's complex and detailed report. When it comes to difficulties, they presented the lack of adaptation and professional capacitation, lack of technological structure, geographic troubles related to the countryside and population's instruction levels.

Concerning the software, Souza et al. (2020) reported the slowness of the CDS, besides constant setting errors, however, the offline data input was a plus, whereas the PEC has more advanced resources, besides greater agility, but the need of an internet connection is a major drawback, because it only works online.

Metrics and Healthcare Technology Assessment (HTA)

For de Alkimin et al. (2016, p. 3), the creation of a healthcare information system needs to clearly distinguish what is knowledge and what is information, and that would be possible with a multilevel modeling. When it comes to system operability in RES, the patterns found by authors' research were: the openEHR Foundation, CEN 13606, Heath Level Seven (HL7, Integrating the Healthcare Enterprise (IHE), DICOM and Medical Markup Language (MML).

The research conducted by de Alkimin et al. (2016) didn't find any studies that presented metrics to evaluate the openEHR model, but the authors mentioned the work of Ahn, Huff, Kim & Kalra (2013, p. 410) who developed quality metrics based on the ISO 9126 for Detailed Clinical Models (DCM). For de Alkimin et al. (2016), the implementation of RES is a hard task that can be minimized with the utilization of software metrics capable to simulate an actual system and promote a quantitative evaluation of the product.

De Alkimin et al. (2016) pointed out how metrics of Objects Orientation (OO) are more adequate to the openEHR standard, thus being able to contribute to develop aspects such as software reusability and extensibility. The authors indicated in a framework (de Alkimin et al., 2016, p. 9) those tools that are accessible for collecting OO metrics, among which:

- those that utilize Java code: CKJM, Classycle, DependencyFinder, InCode, InFusion, Iplasma, Jdepend, Jhawk, Metric (Plugin Eclipse), OO Meter, SourceMonitor, Understand e UniMetrics;
- those that do not utilize Java code: Cantata++, CCCC, ES2, JBOOMT, MetricView, QMOOD++, SDMetrics, Software Architecture Analysis Tool (SAAT), XLSTAT.

For Schall et al. (2017), evaluation markers can promote the extemporaneous interpersonal planning and can contribute in practice to improve the quality of reports, the cohesion of interdisciplinary teams and the identification of patients in case of vulnerability or risk. They also took into account how time is necessary so that patients learn how to properly utilize the tool.

Lima et al. (2019) conducted a comparative study between Conitec and the organs accountable for Healthcare Technology Assessment (HTA) in three nations regarded as highly relevant references for inclusion of new technologies: Australia, Canada and UK. The study evaluated the process of incorporation of new technologies under the viewpoint of an ongoing legislation and the Conitec electronic admission form.

The authors also conducted a literature review in order to understand how the process of incorporation of new technologies takes place within an international scope, through the methodology proposed by the Center for Evidence-based Policy. Besides, they answered questions about resources allocation and individual goals of each component, so as to compare the process goals.

Lima et al. (2019) reported that: Australia has an interconnected HTA program that provides support to the Healthcare & Aging Ministry; whereas in Canada the main characteristic is the fact that the HTA program is state-funded, although it does have a decentralized administration; as for the UK, it does have an independent program with government funds.

The steps for the Conitec process of technological incorporation were described by Lima et al. (2019) and presented according to the synthesis: attainment and analysis of the demand by soon-to-be-incorporated new technologies; literature analysis and economic studies, in order to understand the viability or validation of the technology in question; recommendation report for SCTIE; publishing on DOU; public publishing and implementation of reports in 180 days tops.

Digital technologies, professional capacitation and investments

In a study conducted with resident doctors in General Surgery (n=74), in services in Paraguay (Sandoval et al., 2017), it was identified the user preferences regarding digital technologies among the participants. The electronic devices identified by order of preference were: smartphones (97%), notebooks (34%) tablets (20%). WhatsApp was the main communication tool utilized by resident doctors (96%), both for exchanging information or images, and for making phone calls (34%).

Still according to the authors, the utilization of smartphones was a means to exchange medical information about doubts concerning clinical cases of patients or any

other correlated subject, to read scientific articles or to watch surgery videos, before performing an operation.

Santos et al. (2017) indicated the lack of investments or incoherent distribution of funds for digitalization projects in healthcare, because they are quite expensive. For them, digital tools must be seen as objects and mediators of the processes, but they never replace the final work of professionals. Adding to that idea, Galdino et al. (2016) pointed out that professional skill is so important that is pointless investing in technologies and systems if there's no capacitation to utilize the tools with quality and consciousness.

VI. DISCUSSION

HIS are facilitators to recover and integrate patients' data, favoring interdisciplinary communication. They help to cut costs with paper Gava et al. (2016), which in turn cuts the costs with service inputs. Besides, as seen in Fernandes & Tareco (2016) and Galdino et al. (2016), HIS collaborates with the practical management of healthcare services.

Such findings affirm Rogers' idea (2020) regarding the transformation of data in valuable information in the context of digital transformation. As we've seen in current times, especially because of pandemic context we're living in (years 2020 and 2021), the offer of remote services has exponentially increased and still increasing, mainly in healthcare areas such as Teleradiology, Tele-appointments, Telereport etc.

Carrasco & Medina (2019) highlighted how the SIGGES renders rural populations invisible, which corroborates Rover's (2008) work, presented at the introduction, as well as de Souza et al. (2020), who indicated pertinent questions concerning the implementation in the countryside, both because of the local geography and adhesion of professionals to properly performing the processes.

Among the benefits of Teleradiology, Bashshur et al. (2016) pointed the decrease of patient transfers from rural areas. That's because by having a report remotely issued, doctors would able to refer the most complex cases that actually need intervention of specialized services.

Da Costa & Linch (2020) suggested the need of a leadership over teams that perform tasks of electronic data register of patients, which would promote more quality in the final result of the databank. Thus, healthcare professionals, who see themselves taking the role of electronically registering patients' data, need to be aware of the importance of data quality for professionals who will base their treatments, diagnostics or healthcare management strategies, upon that information.

As for the difficulties to implement HIS because of the lack of both material resources (WHO, 2016f) and human resources (Silva et al., 2019), is crucial the study of viability and financing management that allows the identification of factors that either limit or prevent the propagation of healthcare services in more isolated communities.

Santos et al. (2017) and da Costa & Linch (2020) indicated the need to standardize HIS terminologies, what makes easier to recover patients' data. For this matter, it is paramount the attention and motivation of professionals in order to fill a register with excellence, reinforcing the authors' idea pointing out to the capacitation and professional engagement as important requirements to the HIS final result.

In some cases, they identified how the low quality of data could be due to the patient's own limitations. Although the patient strictly lacks all the necessary information to fill a form, it's necessary to pay close attention and be extra-careful concerning the provided data, thus avoiding or minimizing the construction of faulty database.

Some studies point out to the lack of professional preparedness to utilize TICS (Fernandes & Tareco, 2016; Galdino et al. 2016; Pissaia et al., 2018; Carrasco & Medina, 2019). Concerning that fact, Alves et al. (2016) offered professionals a previous training so they were able to utilize such technologies, with an emphasis on the perception of the clinical importance and evolution of patients in accordance to the effective filling of the EHR and the quality of it.

The initiatives regarding punctual applications of technologies, as in the case of the SUS national card (Gava et al., 2016) or RE (Schall et al., 2017), are the starting point to develop a system network, whether it's public or private, so that such applications enable the evolution of communication relations between services and individuals.

This support to healthcare management is clearly exemplified in services provided by companies, like Feegow (2021), that has several partners well known in the healthcare realm, in which the EHR becomes a centralized data service crucial for the management. As seen in Santos et al. (2017), we realize in practice how the private initiative has more service possibilities and that causes a heterogeneous and unbalanced development among public and private services.

Regarding the implementation of digital technologies in healthcare services that provide support for nursing, as seen in Pissaia et al. (2018) we understand how the data standardization can improve the communication between professionals of different areas, thus contributing to discuss cases and therapeutic approaches that improve the quality of the patient's service.

Such findings reinforce the data provided by Sandoval et al. (2017), in which the smartphone was the main electronic device selected by resident doctors, utilized for

studies, researches, sharing of information and discussion of cases, thus speeding up the processes and bringing more immediate answers to support clinical, therapeutic and surgical decision-making processes.

It's worth highlighting that the incorporation of new healthcare technologies in the SUS goes through the Conitec and, as seen in Lima et al. (2019), it does have a program attached to the government, similar to Australia and Canada. In that regard, we take into account the importance of researches and academic dialogues by experts and healthcare professionals, in order to contribute to the validation of technologies meant to be inserted in the SUS.

Among the found benefits concerning the implementation of electronic registers in healthcare: speed and precision of clinical decisions Schall et al. (2017), organization and dynamism Alves et al. (2016), high performance and security for the patients' data Pashazadeh & Navimipour (2018), clinical analysis for evidence-based support and intervention.

Schall et al. (2017) also indicate the challenges to implement an EHR, such as the interoperability with other systems, but they point out the possibilities to create standardized information. The authors indicate that an EHR needs to have a visual order in the access panel, a physical structure. Regarding the interoperability, de la Escalera & de Azcarte (2018) brought the alternative of the utilization of Big Data as a strategy to improve communication between different systems.

Interoperability seems to be the most important point of intersection of a project that seeks to install a wide, integrative and functional system. Without it, the systems would be limited to meet local demands, with local impacts, contributing even more to increase the differences in the access to an equal healthcare.

The utilization of smartphones has changed the way the societies relate and correlate within a global context; a fact that was potentiated by the Covid-19 pandemic context, in which people need to keep social distancing and communication has occurred mostly by digital means, during the periods of isolation.

Add to that, the development of social media and countless applications in an image-based landscape in which people interact more with companies and services, influencing their reputation, as seen in Rogers (2020). Besides, we notice the issue of a network society, as seen in Sandoval et al. (2017), in which doctors create discussion networks to address their own interests.

In all segments there is a quest for strategies that take us towards social inclusion and democratization of services. In a system like the SUS, for instance, whose main characteristic is decentralization, it's up to the public management organs to make sure this occurs, in order to minimize the impacts in the whole national system.

The lack of access to healthcare services and modern technologies in rural or isolated communities may soon provoke the discussion of subjects like regional management and investments, the absence of resources, besides highlighting the fact that expectations about current democratization and digital inclusion are not met.

We analyzed the ACR® Dose Index Registry (DIR), a system that operates since 2011 in the register and transmission of patients' automatic data, and we were surprised by the fact that not a single article addressing the "register of dosage markers and radiological protection" was found in the HIS.

Finally, some initiatives to register dose indicatives can be seen in:

- GE Healthcare (2020), that developed DoseWatch, a radiation and contrast dose management system used in CT scans, also applicable in mammography, radiographs and other modalities;
- Siemens Helthineers (2021), that offers teamplay Dose, a clouding dose management and continuous assessment system for multiple sources of ionizing radiation, which analyzes the protocols used in performing exams as well as the accumulated dose in patients;
- Philips Healthcare (2021), that developed the web-based Philips DoseWise software, which performs everything from the analysis to the presentation of dose reports, contributing to patient safety, in compliance with legislation. Through it, it is possible to view the dose in each exam performed, as well as the individual dose, the maximum dose for the skin and other organs; and
- OpenREM (2019), an application used to collect reference and representative dose data from patients, which presents the results through a web interface. It is free and open source and supports CT, X-rays, fluoroscopy and mammography. It can be installed on platforms running Pyton, so it is compatible with Linux, Windows, Mac PC or server operating systems.

VII. CONCLUSION

This article analyzed the works about HIS and the applicability of digital technologies in healthcare. Regarding the initial questions, we conclude that:

1) Digitalization in the healthcare realm does have several benefits, among which: concentration and recovery of patients' data, in order to be utilized for purposes of management and trackability, allowing the practice of evidence-based medicine; reduction of costs with paper, physical space; easy dialogues among interdisciplinary and multidisciplinary professionals, so as to promote health generation.

2) The applicability of computing in healthcare has examples like the ER or EHR; the utilization of applications, such as WhatsApp, to exchange messages among healthcare professionals; the utilization of smartphones for self-educative purposes; the support of Big Data to develop HIS, whose main factor regarding a system of broad scope, is the interoperability among the system's components.

3) As for the implications or barriers to implement a HIS, we can mention the lack of investment in personnel and structure; the lack of professional training to utilize a HIS; the lack of commitment by professionals, while feeding data into a HIS; the lack of terminologies standardization between systems, caused by initiatives with strictly local interests; the lack of communication between different HIS.

The main gap identified was the lack of markers, registers or trackability of ionizing radiation doses, from medical exposure to modalities such as digital radiology, computerized tomography, mammography, bone densitometry and nuclear medicine.

Maybe the results are different in other database or within other research scopes, but as far as the present work goes, it' implied that the subject is poorly researched and it's evident the existence of an aperture for research and development of systems similar to ACR® Dose Index Registry (DIR), mainly in Brazil.

Thus, we conclude that the benefits of a EHR could include trackability markers concerning the doses patients are submitted to, for purposes of dosage control and basecare of the negative effects from exposure to ionizing radiation. Therefore, the data would become valuable information to support the healthcare practices within the scope of Radiodiagnostic, thus contributing to the patient's safety, consequently promoting health.

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The sanitary void of soybeans as a measure to control Asian rust and the importance of official plant health defense actions in this context

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***Abstract*—** *In Mato Grosso do Sul agribusiness accounts for 30% of gross domestic product - GDP, being the 5th largest soybean producer in the country and the 4th in corn production. According to the state government, the 2020/21 soybean crop exceeded forecasts and reached 13.305 million tons, a volume 17.8% higher than that of the 2019/2020 crop. Asian rust is one of the diseases that most affect and compromise soybean production. The causative agent is the fungus Phakopsora pachyrhizi, which is biotrophic, polycyclic and has a large amplitude of hosts, which gives it the ability to survive from one agricultural year to another, due to "green bridges". Asian rust, which was rapidly softened every year, was so severe in the 2005/2006 crop that there was a mobilization among those involved in the production chain, to try to standardize the activity and reduce the problem in the following harvests. This joint effort, with forums and meetings, came the creation of a state legislation based on the prevention and control of Asian Soybean Rust in Mato Grosso do Sul. Its initial milestone was State Law No. 3,333, of December 21, 2006, whose purpose was to implement the sanitary void of soybeans and make it mandatory to control raccoon plants after harvest. To make the effects of the sanitary void more effective, State Law No. 5025, of July 19, 2017, prohibited the cultivation of soybeans after*

soybeans, in the same area and in the same agricultural year. Then, the Secretary of State for The Environment, Economic Development, Production and Family Agriculture - SEMAGRO published Resolution SEMAGRO No. 648, from August 15, 2017, establishing the soy sowing calendar from September 16 to December 31. In order to characterize the plant health defense actions related to the supervision and application of legislation dealing with the sanitary void, for the purpose of maintaining the control of Asian soybean rust in the State of Mato Grosso do Sul, it was carried out the survey of information of inspection actions with the state agency, from 2009 to 2021, stored in the IAGRO database. The information showed that, after the soybean sanitary void law, fiscalization and sanitary education work positively influenced compliance with the legislation and few producers deliberately violated it, especially with regard to sowing during the sanitary void period. The greatest number of infringements was due to the lack of registration of the planting areas, followed by the non-control of spontaneously growing soybean plants.

I. INTRODUCTION

Brazil is one of the main exporters of agricultural products in the world, serving more than 180 countries, having as main buyers China, MERCOSUR countries, the European Union and the United States. The main exportsegments of products from Brazilian agribusiness are the soybean complex (36.9% share); meat (19.2% share); forest products (11.5% share); cereals, flours and preparations (8.6% share) and sugar-alcohol complex (8.4% share), which had an 84.5% share in the total exports of August 2021 [1].

It should be noted that all agricultural production is carried out in about 30% of the Brazilian territory, being only 7.8% for agriculture as a whole and only 4% destined for soybean planting [2], which proves the country's commitment to sustainable production and environmental preservation.

In Mato Grosso do Sul, in 2018, agribusiness accounted for 30% of gross domestic product – GDP, constituting the main segment of the state's economy[3]. In 2020, the state's Gross Production Value – VBP increased by 29%, reaching R$70.9 billion. The State is the 7th in the Brazilian agribusiness production ranking and agriculture has been standing out year by year. While the VBP of livestock production totaled R$ 17.7 billion in 2020 and grew 14% compared to 2019, the VBP of crops increased by 34.4% in this period, reaching R$ 53 billion[4].

Soybean is grown throughout the state of Mato Grosso do Sul, except for the Pantanal biome region, with emphasis on the northern region (Chapadão do Sul) and the southern region of the state (Maracaju, Dourados). However, there has been an advance in grain planting areas in some traditionally livestock regions, in which soybean areas have been increasing in place of pasture areas, especially where they present some degree of degradation [4].

Asian rust is one of the diseases that most affect and compromise soybean production, which can cause losses of up to 90% in untreated areas [5]. In the 2001/2002 crop, Asian rust reached about 60% of the Brazilian soybean area. In Mato Grosso do Sul, São Gabriel d'Oeste, Chapadão do Sul and Costa Rica were the most affected municipalities, recording income losses ranging from 30 to 75% in the last two [6].

The severity of the disease in the 2005/2006 harvest was aggravated by two causes: favorable climatic conditions, which allowed the early emergence of the disease, still in the vegetative stage and also by control failures, because the applications were timed, starting in flowering, but delayed to that context [7]. The severe situation caused those involved in the soybean production chain to mobilize to seek the standardization of the activity and reduce the problem in the following harvests. This joint effort, with forums and meetings, came the creation of State Law No. 3,333, of December 21, 2006, based on the prevention, control and eradication of Asian Soybean Rust in Mato Grosso do Sul.

The main pillar of this law is the control of soybean sowing, which in Mato Grosso do Sul, is allowed soon after the end of the soybean sanitary void, and the sowing calendar from September 16 to December 31, is established, according to SEMAGRO Resolution no. 648, from August 15, 2017.

Thus, this study had as general objective to characterize the actions carried out by IAGRO in relation to the sanitary void of soybean in the control of Asian rust.

a) Origin, domestication and dissemination of soybeans in the world

The oldest literary reference about soy would be the one contained in the Pen Ts'ao Kang Mu herbarium, written by the Chinese Emperor Sheng Nung, in imprecise date, between the years 2838 and 2383 BC. However, Chang & Watson (no / d) cited by Bonetti (1981), suggest that only dates recorded in history after 814 AD are accepted as the most correct [8]. According to Hymowitz (1976), the emergence of soybeans as a domestic plant took place in the 19th century. XI BC., in the northern half of China, which is the main center of origin of the species and assumed that the first crops occurred during the Shang Dynasty, between 1500 and 1027 BC. From the 17th century to the 19th century, it was introduced in several countries and was taken from Japan to Europe (1712). In the United States it was introduced in 1804, where it acquired importance only in the year 1880, as forage. In 1890, many experimental agricultural stations had experiments with soybeans, but it was only in 1941 that there was significant expansion of the area for grain production in that country.In Brazil, according to the history established by Bonato & Bonato (1987), soybeans were initially brought to Bahia in 1882 for varietytesting. In 1892, the first studies were initiated in São Paulo, at the Agronomic Station of Campinas (current IAC). In Rio Grande do Sul, in 1901, the first performance data of the species were obtained, but the official introduction of culture in the State is attributed to Professor F. G. Graig, from the School of Agronomy and Veterinary Of the Technical University (now UFRGS), in 1914. Only between 1946 and 1950, variety crops were started for behavior observation in several regions of Brazil: PR, SP, MG and RS.

Outside the experimental fields, the first plantations for consumption in food were made in 1908 by Japanese immigrants in the State of São Paulo [8]. Soybean cultivation on a commercial scale began in Rio Grande do Sul in 1941, the year also of the construction of the first soybean processing plant. Initially, the cultivation aimed at the production of forage and grains for the rooting of pigs. With the expansion of crops, in 1949 the first export of Brazilian soybeans occurred, of about 18,000 tons, when Brazil began to appear in international statistics as a soybean producer[11].

b) The expansion of soybean cultivation to the Midwest and North of the country

In the late 1960s, commercial soybean production became a strategic necessity. The country intended to increase the production of pigs and poultry, generating demand for soybean meal. Soybean planting then emerged as a summer option in succession to wheat. In the early 1970s more than 80% of the volume produced was concentrated in the three states of the Southern Region. During this period, the valorization of soybeans in the international market sharpened the attention of farmers and the Brazilian government [1] and the expansion of the crop became of interest to both.

Given the different edaphoclimatic conditions of the country, the pioneering spirit of the producers and the possibility of expanding the cultivated area in Brazil, with the leadership of the Brazilian Agricultural Research Company - EMBRAPA and participation of several universities and private companies, there were investments in technological research in several areas of agronomy such as: genetic improvement, agrometeorology, fertility and land use, phytosanitary defense, etc. to adapt culture to the various Brazilian conditions and ecosystems.

According to FERREIRA and SILVA (2019), in the late 1970s the Brazilian Midwest was considered a barn of opportunities for the expansion of the agricultural frontier and many factors encouraged migration from the south to the west center of the country. The land was low cost, had good conditions of relief, flat in large part, and well-defined dry and rainy weather. And also the special credit lines that were opportunistic by the Government, facilitated investments. This encouraged the occupation of large "empty spaces" in central Brazil, although the lands had yet to be cleared, demanding a lot of persistence, determination and a lot of work.

Thus, the Midwest emerged as a new productive option as research in the area of soils and fertility, mechanization and genetic improvement of soybeans intensified, seeking cultivars more adapted to the conditions of the cerrado, previously considered a poor soil, but which came to be seen with a new look. From the constant insertion of technology making the soil fit for the practice of agriculture, allied to a geopolitical condition that favors production, the Midwest has achieved, each year, increasingly higher production rates [14].

The achievement of good results of the research provided and continues to provide the expansion of the agricultural frontier to the northern region of the country (Fig. 1) and excellent productivity.

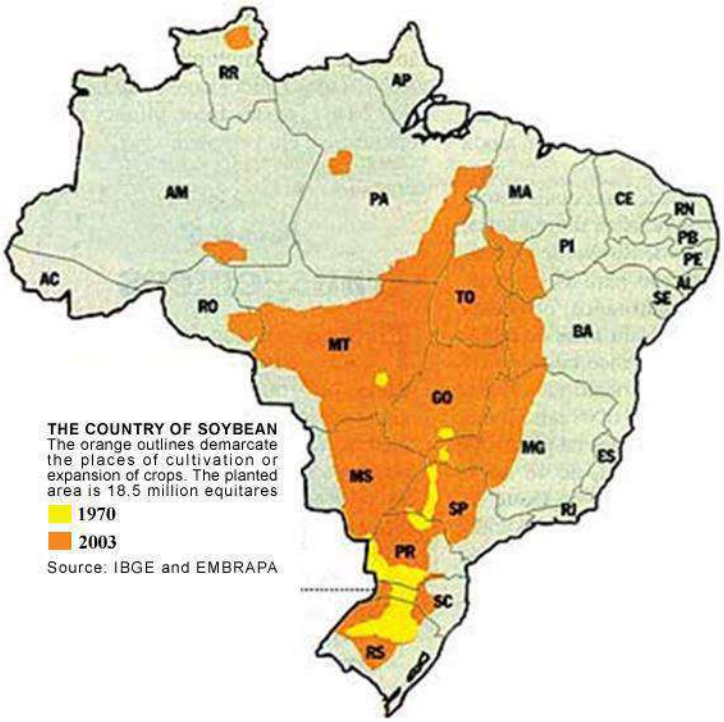

Fig. 1: Expansion of the soybean plantation area in Brazil from 1970 to 2003.

Source: Agrolink-a, (2021).

c) Soybeans in the State of Mato Grosso do Sul

The expansion of agricultural areas in Brazil and, mainly, soybean cultivation in the Midwest, was consolidated as a result of stimuli and economic advantages combined with the warming of the international market [12]. An advantage for the State of Mato Grosso do Sul in the process of geographical expansion for soybean production, towards the Cerrado, were the large dimensions of the land, as evidenced by Faccin (2017) and Ferreira & Silva (2019), when presenting the fact as one of the variables involved in the regional competitiveness of the State. Thus, the structuring and specialization of the south-mato-grossense territory occurred in order to meet the demand of the sojicultorsector[12][15].

In Mato Grosso do Sul, the significant increases in the production of the soybean agro-industrial complex are the result of the agricultural modernization acquired in recent decades [16]and soybean production, in the last 20 years, has grown 320%, keeping the state in the position of 5th largest producer of grain in the country [17]. Thus, soybeans play a major role in the command of territorial structuring, with the production of large-scale agricultural commodities for export as the economic base of the State[12].

In Brazil, exports of basic products from the primary sector (fig. 2), with little or no added value, such as those of the soybean complex (crushed soybean and soybean oil meal and residues), represented 11.9% of the value of the products exported by the country in 2018. Similarly, the exporting matrix of the stateof Mato Grosso do Sul (fig. 3), compared to exports from Brazil, it portrays the same composition, in which soy complex products occupied the first position, with 37.4 % of the value of exportedproducts [18].

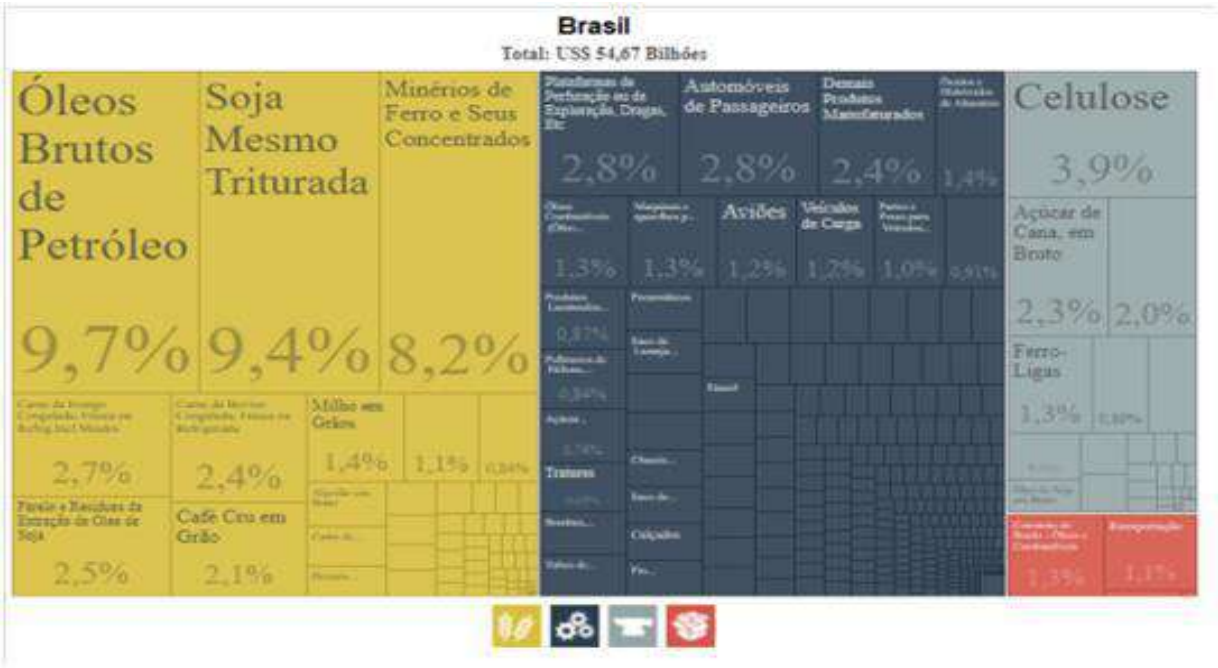

Fig. 2: Overview of exported products: participation in relation to the value exported in 2018.

Source: Comex Vis/MDIC Reproduction (2019).

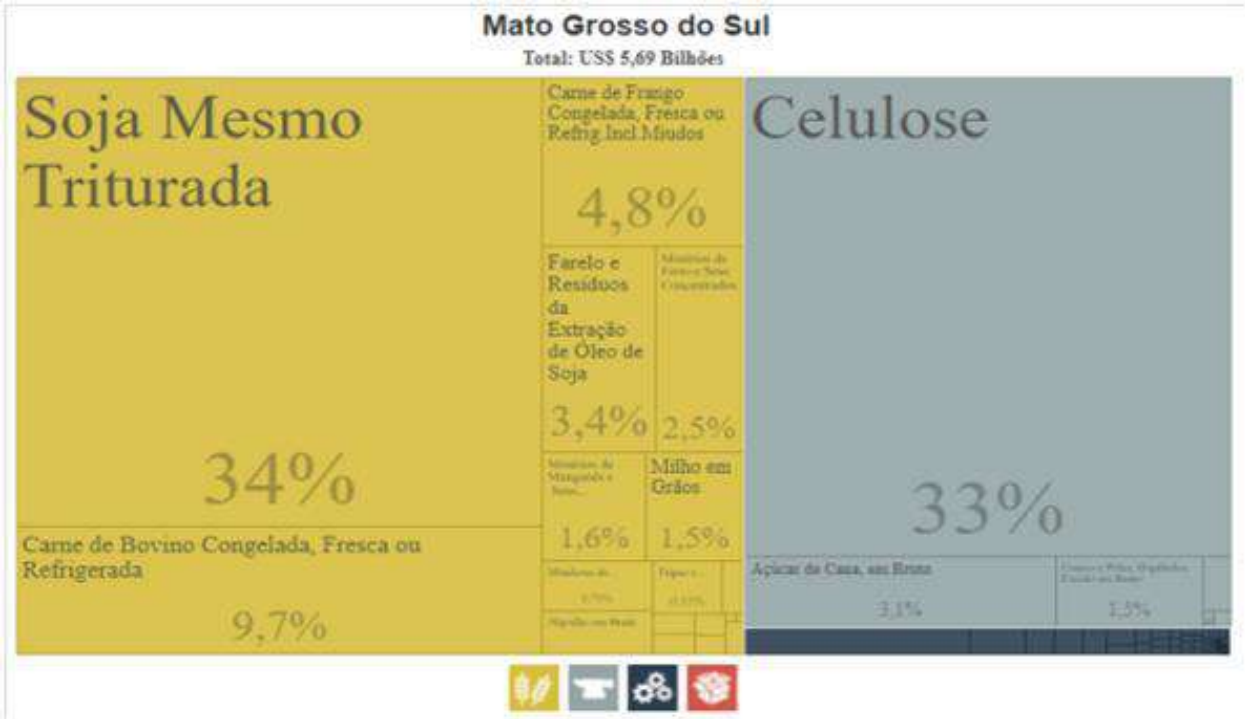

Fig. 3: Mato Grosso do Sul: Overview of products exported in 2018.

Source: Comex Vis/MDIC Reproduction (2019).

The soybean chain is among the activities that form the basis of the South Mato Grosso economy, contributing to the maintenance of the industry sectors and also the services derived from primary products, created for the implementation of the few main activities.

The use of precision technology in agriculture combined with rural management comes year after year,

providing increased productivity. Agricultural research in Mato Grosso do Sul generates technologies that, when incorporated into production systems, ensure their viability, with consistent technological bases [19].

According to data from SEMAGRO (2021), in Mato Grosso do Sul, in the 2020/21 harvest soybean production reached an all-time high, when 13,305 million tons of soybeans were produced in an area of 3,529 million hectares[17]. The productivity of 62.8 bags/ha exceeded expectations and the volume produced was 17.8% higher than that harvested in the previous harvest, which contrasts with the increase of only 4% in the planted area. Among the municipalities with little agricultural tradition and which has been growing in the planted area of soybeans, are Campo Grande and Bandeirantes (fig. 4), these in recent years, have replaced pastures, mostly presenting some degree of degradation, by the cultivation of legumes. Also other municipalities, besides those already mentioned, such as Jaraguari, Camapuã, Itaquiraí, Paraíso das Águas, Nova Andradina, Anaurilândia, Naviraí and Ribas do Rio Pardo are having their cultivated areas significantly increased[19].

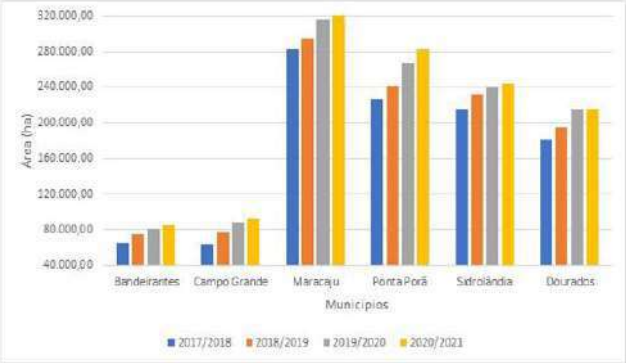

Fig. 4: Evolution of soybean cultivated area in some municipalities of Mato Grosso do Sul.

Source: CONAB, 2021

d) State Agency for Animal and Plant Sanitary Defense - IAGRO

With the creation of the State of Mato Grosso do Sul in 1977, it was necessary to implement the inspection and health defense service in the new state and then, under Decree-Law No. 9 of January 1, 1979, the Department of Agricultural Inspection and Defense of Mato Grosso do Sul - IAGRO was created. Subsequently, through Law No. 2,152, of October 26, 2000, the agency received the current name: State Agency for Animal and Plant Sanitary Defense, maintaining the old acronym.

IAGRO is an autarchy, with its head and fore in the State Capital. It is bound by the Secretary of State for The Environment, Economic Development, Production and Family Agriculture - SEMAGRO, which, according to Law No. 4,640 of December 24, 2014, is the body responsible for supervising the activities of the Agency, which has legal personality of public law, own assets, technical, administrative and financial autonomy, and indefinite duration, under the law, being the body responsible for operationalizing and implementing the standards of the Unified System of Attention to Agricultural Health - SUASA.

Purposes of the State Agency for Animal and Plant Sanitary Defense:

> *1.Implement public policies in the areas of inspection, inspection, health education and health, with the objective of promoting, maintaining and recovering animal and plant health, the quality of its products and by-products, through health defense, control, inspection and inspection of products and by-products of agricultural origin, inspection of agricultural products and biosafety activities, to ensure human health.*
>
> 2. *Comply with and enforce the obligations delegated by the Executive Branch, with regard to legislation governing the protection of animal and plant health and the control and inspection of agricultural products, goods and services, processes and technologies achieved by the system of attention to agricultural health.*

IAGRO is the agricultural defense authority of the State of Mato Grosso do Sul and prioritizes promoting, maintaining and recovering the health of animals and vegetables, as well as the quality of agricultural products, their derivatives, especially in relation to harmlessness, acting in prevention with a view to quality and the defense of the diffuse rights of consumers. Decree No. 15,519, of October 14, 2020, assures IAGRO the other prerogatives necessary for the proper exercise of its duties.

In addition to implementing actions to meet mapa's federal programs, it also implements actions not covered by these programs, but which are of strategic and economic importance to the state, due to the need to preserve public health, animal and plant health, or due to compliance with rules established by international organizations such as the OIE, CIPV and Codex alimentarius, or to meet the demands of the Public Prosecutor's Office.

IAGRO's work in relation to agricultural production goes beyond inspection, surveillance and inspection. From these actions, problems and failures in the productive system are often found that can harm both the health of the general population, as well as the finances of producers,

municipalities and the state. As an example is the recent introduction in south-mato-grossense territory of the bacterium causing HLB disease in citrus and cases of misuse of pesticides, which can leave residues in food, not meeting the requirements of the PNCRC - National Plan for Control of Waste and Contaminants, harming consumers and also international trade, subjecting the country to commercial retaliation, in addition to causing damage to the environment.

Many of the problems of health defense can be minimized in the long term, provided that health education work is continuously developed that, together with the sanctions provided for in the laws governing agricultural activities, will consciously and lastingly promote a change in behavior in producers and others involved in production processes.

The work of health education and awareness carried out by IAGRO is based on the National Program of Sanitary Education in Agriculture - PNESA, created by The Normative Instruction MAPA no. 28, of May 15, 2008, meeting the other national health defense programs of MAPA and other topics of interest to health defense, in order to bring preventively to the target public the technical knowledge and requirements of sanitary legislation, in order to make you aware of the production of safe food. Educational actions are developed, assuming that all those involved in production processes should be aware of their responsibility in relation to animal and plant health defense and the use of agricultural insumuins.

e) Characterization of soybean rust and its occurrence in Brazil, the Midwest and Mato Grosso do Sul

Asian rust, caused by the fungus Phakopsora pachyrhizi, is among the main diseases of soybeans and has greater potential for crop damage in the country. Early defoliation is the main damage caused by Asian rust, which causes a decrease in photosynthetic and photonatorates, preventing the complete formation of grains, with consequent reduction of productivity [20].

The level of damage that the disease reaches and the damage caused will depend on what stage of growth the plants are in when the fungus begins the colonization of leaf tissues and also that the climatic conditions are favorable to the multiplication of the pathogen, which can reach 70% [16]. In studies conducted by Sumitomo Chemical Brasil (2021)[5], it was found that, if not controlled, because it is an aggressive microorganism, Asian rustcan cause losses of up to 90% in soybean crops.

At any stage of development, soybean plants can be infected by Asian rust, but the fungus attack becomes more intense from the closure of the crop canopy, when the highest incidence is observed due to the formation of a microclimate favorable to infection. Shading and higher humidity are factors that give protection to spores against the effects of UV radiation and direct solar radiation, which have a deleterious effect on their survival [21].

The onset of the disease occurs when uredospores (spores) germinate and begin colonization in the host tissues. The first symptoms are the appearance of tiny dark scores (1 mm), greenish to greenish-gray on the leaf. With the evolution of the disease, lesions (2 to 5 mm) of light brown color with darkened spots appear. On the abaxial face of the leaves are the uredias (breeding structure), which break and release the uredospores, which are transported by the wind and which restart the cycle [20]. After infection by the fungus, the leaves become chlorotic, dry and early dehiscence occurs. This will impact the photosynthetic rate, which will be lower. Therefore, the earlier there is infection and defoliation, the smaller the size of the grains with greater loss of yield and quality [22].

The first record of Asian rust in Brazilian crops occurred in 2001, in Paraná, from there, in the following harvests, it spread throughout the other producing regions. The evolution of the disease throughout Brazil was very rapid and in the 2001/2002 harvest, it reached about 60% of the Brazilian soybean area, according to a study by Yorinori et al. (2005) cited by Godoy et al. (2020) [21]. In this harvest, in Mato Grosso do Sul the most affected municipalities were: São Gabriel d'Oeste, Chapadão do Sul and Costa Rica with a record of income losses ranging from 30% to 75% in the last two [6].

Characteristics of the pathogen are very important in the maintenance and persistence of the disease. According to Hartman et al. (2015) and Godoy et al. (2016), mentioned by Godoy et al. (2020), the reproductive structures of the fungus are miniature and easily disseminated by the wind. In addition, the presence of soybeans for most of the year in the producing regions that have a favorable climate for the development of the disease, were essential for the rapid expansion of Asian rust in Brazil[21]. In this sense, Yorinori et al. (2004) stated that soybean cultivation in the off-season (June/July) led to the early onset of the disease in the 2003/2004 crop, mainly in the Midwest and North regions of Brazil, being detected in 2004 in all soybean producing regions in Brazil, except in Roraima, in the Boa Vista region[6].

The vertiginous spread of the disease led to the created in 2004 the Antiferrugem Consortium, which is a network of laboratories, researchers from public and private institutions and cooperative trials for fungicide tests,

distributed in all Brazilian regions in order to monitor the occurrence and generate up-to-date information about the disease [1].

Because Asian rust is a polycyclic disease, capable of completing several cycles and spreading for long periods, it is that even after the end of the commercial harvest, the fungus continues to survive and reproduce in alternative hosts and raccoon soybean plants [5] that form the so-called "green bridge", essential for maintaining the inoculum source at high levels at the beginning of the next crop. This situation is aggravated by the cultivation of soybean scum. In Brazil, between 2006 and 2007, due to the severity of the disease and difficulty in control, which caused many problems for sojicultores, the sanitary void of soybeans (period of absence of soybeanin the field) was implanted in order to reduce the pressure of inoculum at the beginning of the following crop [23].

Data from the Antiferrugem Consortium show that in Brazil, as in the State of Mato Grosso do Sul, the number of outbreaks of the disease increased rapidly from the 2005/2006 harvest, peaking in the 2006/2007 crop (Fig. 5). On the other hand, the historical series of Asian rust records in MS shows a 4-year fall in records after the implementation of State Law No. 3,333 of December 21, 2006, establishing the sanitary void of soybeans as a tool in disease control. This makes evident the importance of phytosanitary measurement in the control of the disease, which combined with the awareness of rural producers and the use of preventive measures have achieved satisfactory results in grain production.

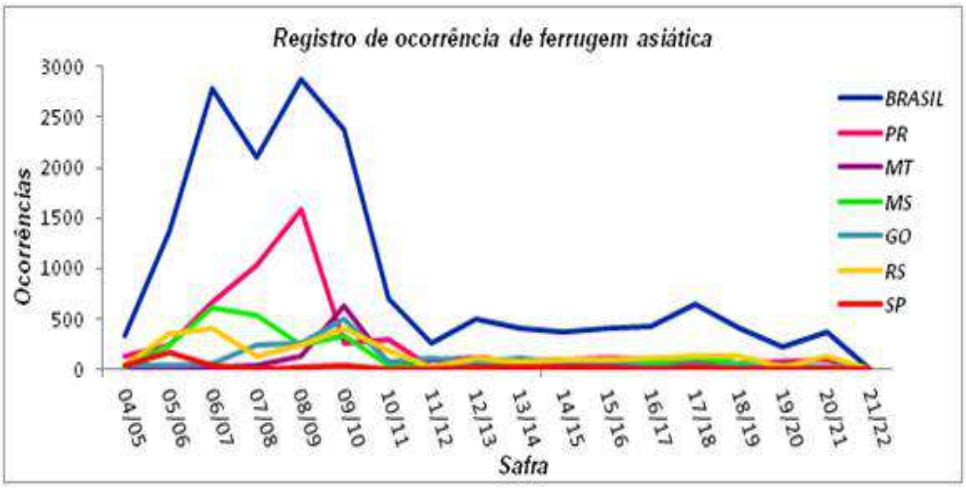

Fig. 5: Occurrences of Asian rust in Brazil. Source: Antirust Consortium/2021.

Also according to data from the Antirust Consortium, in the current crop (2021/2022), until the beginning of November, there is the report of only one focus of Asian soybean rust in the state of Roraima-RR registered in mid-September, probably due to the agricultural calendar in Roraima being different from the calendar of the rest of the country (the state is located in the northern hemisphere, in which planting usually takes place in April and June). In Brazil, in the 2020/2021 harvest, 377 foci of Asian rust were recorded, of these 25 occurred in the state of Mato Grosso do Sul.

f) Legislation applied to asian rust control

In studies conducted by Yorinori et al(2004), they found the increasing incidence and wide dissemination throughout The Brazilian territory of Asian Soybean Rust from the 2001/2002 harvest. That is why in Mato Grosso do Sul, entities linked to the sector and producers converged on the need to discipline the activity of sojiculture in theState [6].

Aiming at strengthening the agricultural production of legumes and mitigating economic risks to producers, joint phytosanitary strategies for the prevention, control and eradication of the disease were instituted through specific legislation. The strategies were supported by the research, the participation of the productive sector, representatives of the public sector and other invited relevant entities or bodies [24].

The initial milestone in Mato Grosso do Sul was State Law No. 3,333, of December 21, 2006, which established, for any areas of the state, regardless of type or location, the sanitary void of soybeans, which is the period in which there should be total absence of soybean plants, whether planted or raccoons, from 15 June to 30 September [25] date which was subsequently amended. It also determined the control of raccoon plants, those from grains abandoned

or lost in the soil at the time of harvest or during grain transport.

Another action that was implemented as mandatory for soybean producers is a declaration of soybean planting areas, which should be done annually, through registration on the IAGRO website, whose deadline was set in later law. It also stipulated that it is the responsibility of the sojicultor to always follow up during the conduction of the crop, which is the monitoring of plants for detection of the disease and realization, when due, and according to the prescriptions of its technical responsible, chemical, biological or mechanical control of prevention or fight of the disease [25].

In the same law, the State Committee for the Control of Asian Soybean Rust was created. The Committee, assertively, due to the robust technical staff, was responsible for employing dynamism to the sojiculture of the State, even though the measures it deliberated became inflexible legal instruments. Developments in agricultural production have triggered the modernisation of legislation, which can be updated over time, by appropriated legal instruments so as not to hinder rural progress [24].

The current fixed members of the Committee are: the State Agency for Animal and Plant Sanitary Defense - IAGRO; the Agrarian Development and Rural Extension Agency - AGRAER; Association of Soybean Producers of the State of Mato Grosso do Sul - APROSOJA/MS; Regional Council of Engineering and Agronomy of Mato Grosso do Sul - CREA/MS; Foundation for Agricultural Research Support of Chapadão - Chapadão Foundation; MS Foundation for Research and Dissemination of Agricultural Technologies - MS Foundation; Brazilian Agricultural Research Company - West Agricultural Research Center - EMBRAPA/CPAO [26].

On November 24, 2008, State Decree No. 12,657 entered into force, regulating State Law No. 3,333.[Later, it was necessary to make some updates of this legislation through the changes and insertions of instruments promoted by other laws. Law No. 3,606, of December 19, 2008, among other changes, instituted the socio-educational measure, which allows the conversion of the fine due to the lack of registration of planting areas participating in a lecture on the sanitary void of soybeans and relevant legislation. This law also set the period of regular registration of soybean planting areas in the state, which is from September 1 to January 10 and should be doneannually on the IAGRO website[26].

Two important changes were made by Law No. 4,218 of July 11, 2012. One was the anticipation of the end date of the sanitary void from 30 to September 15, standardizing the calendar with that of neighboring states. The other was the setting of June 14 as a date until the control of the non-control of spontaneously growing soybean plants, already mandatory by Law 3333, by the respective legal guardians, in any public or private areas where they have germinated, including rural properties, roads, warehouses, etc. and even in urban areas, and all voluntary soybean plants, must be controlled and destroyed before the start of the sanitary void [27].

The most recent complement ation was made by Law No. 5,025 of July 19, 2017, which prohibited the planting and cultivation of soybeans succeeding soybeans in the same area and agricultural year, the popular soybean safrinha. It also instituted the planting calendar for soybean cultivation, which is allowed from September 16 to December31. It should be noted that soybeans cannot be sowing before September 16, even if seedling emergence only happens after the start date of the sowing calendar.

The government of Mato Grosso do Sul, through SEMAGRO, published RESOLUTION SEMAGRO no. 648, of August 15, 2017, which ratified the existing state legislation, in addition to meeting the determinations of the new PNCFS[29].

At the federal level, the Ministry of Agriculture, Livestock and Supply (MAPA) was initially established, initially the National Program for the Control of Asian Soybean Rust (PNCFS) by Normative Instruction No. 2 of January 29, 2007 [30], which is currently repealed and replaced by the new PNCFS of Ordinance No. 306 of May 13, 2021 [31] . In it, mapa establishes phytosanitary measures for pest control and competencies to the State Organs of Plant Sanitary Defense.

The current PNCFS, established that the period of sanitary void must have a minimum duration of 90 days, with annual occurrence, be published annually by MAPA, with the decision taken together with the State Organs of Plant Sanitary Defense, and that the dates of coverage of each Unit of the Federation, can be established in a regionalized manner, with different dates, within the same Federation Unit. It also implemented the sowing calendar, which was defined as the single period of up to 110 consecutive days, for the start and end dates of soybean sowing. The new PNCFS also made mandatory the registration of soybean planting areas and delegates the competence of receiving it to the State Organs of Plant Sanitary Defense [1].

The entire legal framework in force can be translated, to Mato Grosso do Sul, in some phytosanitary measures that must be taken together by all producers, concomitantly.

Any disagreement with legal phytosanitary measures will cause the offender to receive administrative sanctions,

such as fines, destruction or elimination of irregularly cultivated crops and voluntary plants or socio-educational measures.

g) Asian rust control strategies in soybeans

Asian soybean rust is a disease that requires planning and use of different management strategies, including before planting and, to achieve control results, as efficient as possible, it is mandatory to integrate preventive cultural measures. As a strategy in the management of the disease, Embrapa recommends the absence of soybean sowing and the elimination of voluntary plants in the off-season through the sanitary void to reduce the fungus inoculum.

Another technique adopted as a disease escape strategy is the use of early cycle cultivars and soweds at the beginning of the recommended season, according to agroclimatic zoning and also the use of fungicides in a preventive manner. These measures aim at preventing the disease from leakage in relation to the presence of the pathogen and/or the environmental conditions more favorable to its development Embrapa (2017) or Godoy et al., 2017[1][22].

The occurrence of Soybean Rust is closely related to weather conditions. Thus, meteorological information obtained with the monitoring of temperature and relative humidity, and other climatological variables (rainfall, dew point and leaf wetting) are used as a subsidy in the prevention and control of the disease. According to Sentelhas (2004), the duration of the leaf wetting period (PMD) is one of the most important factors that influence the propagation and severity of plant diseases caused by fungi and bacteria, because the presence of water in liquid form on the surface of plants allows the germination and penetration of phytopathogenic agents in leaf tissues. In this sense, the predictions about the time for the near future are important for decision-making about the treatment with fungicides in relation to the installation and/or evolution of soybean rust.

It also influences the development of the disease the microclimate that forms inside the crop canopy, because it is related to the spacing between the planting lines, which influences the ventilation between them and the dispersion of moisture. Maldalosso et al., 2010, apud Lemes & Gavassoni (2015), observed that greater spacing between the lines (60cm) provided lower values of accumulated disease and higher productivity[32].

Regarding the biological control of the fungus Phakopsora pachyrhizi, Goellner et al. (2010), apud Lemes & Gavassoni (2015) report that there are few alternatives studied: two species of hyperparasite fungi Lecanicillium psalliotae and Simplicillium lanosoniveum, which develop in leaves already infected by P. pachyrhizi, reducing the pustules of this. However, despite the promising results, there are some limitations, such as leaf wetting necessary for the development of hyperparasite species, which hinder and limit their use, even if associated with other control methods[32].

Rust management is mainly done by the use of chemical control, however, the high number of applications evidenced in recent years, results in loss of fungicide efficiency and development of resistance, since the characteristic of being polycyclic, favors adaptation to active ingredients, due to a series of mutations that accumulate in the genome of the fungus, as reported by Schmitz et al. (2014); Klosowski et al. (2016); Simões et al. (2018) apud EMBRAPA, 2020[1]. Converging with these conclusions, Reis et al, (2018) observed that the use of fungicides impacts on the cost of production andincreases the risk of selection of resistant fungal lines and both factors are dependent on the number of sprays and that no scientific criteria is adopted to define when to make the first application[33]. This process is cyclical, especially if strategies to combat resistance are not adopted [32] as the use of fungicides with different mechanism of action.

There are three main groups of active ingredients recommended for chemical control of Asian soybean rust and recorded in mapa: Demethylation Inhibitors (MDI) – "triazois"; External Quinone inhibitors (IQe) – "strobilurines" and Succinate Dehydrogenase Inhibitors (ISDH) – "carboxamides". In addition to these, there are multisite or protective fungicides (mancozeb, chlorothalonil, copper-based fungicides) which are the combination of more than one active ingredient in the formulation [21].

In general, among the control alternatives for diseases, genetic resistance is a solution that requires a long period of development, but which becomes an excellent form of disease management. In the case of soybean rust, the plant reaction will interfere with the degree of the injury caused by the pathogen and the viability of its reproduction in the plant.

The fig. 6 demonstrates the differences between the degrees of resistance to soybean rust. Resistant plants do not present lesions (A); plants with partial resistance present RB-type lesions, where the pathogen develops the lesion, with reduced urenian production and size (B); susceptible plants present TAN-type lesions, which show full reproduction of the pathogen and are indicative of susceptibility (C).

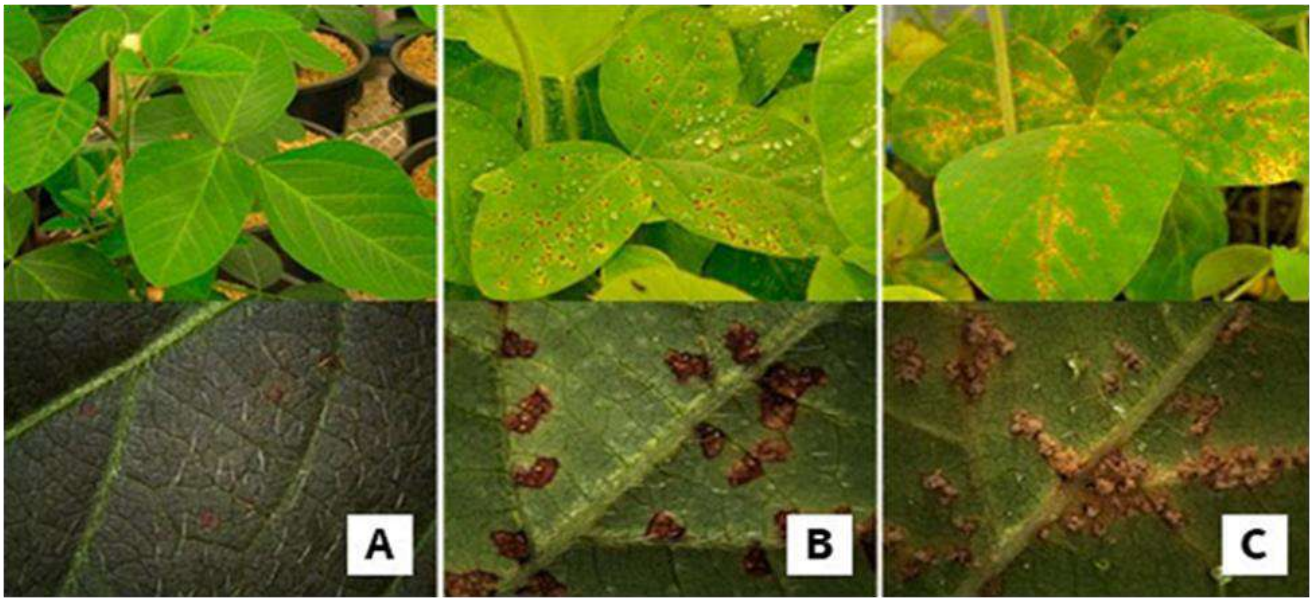

Fig. 6: The three types of qualitative response of soybean to P.pachyrhizi infection: immunity or complete resistance (A), RB lesions or incomplete resistance (B) and TAN lesions indicative of susceptibility (C). Source: Pionner, 2016

With regard to specific resistance to P. pachyrhizi, seven dominant genes were identified: Rpp1 [34], Rpp2 [35], Rpp3 [37], Rpp4 [38], Rpp5 [29], Rpp6 [37] and Rpp7 [40]. However, these genes confer resistance to some biotypes, but are not effective against all populations of the pathogen.

Cultural Control - Soy Sanitary Void in Mato Grosso do Sul

The most important and ancient phytosanitary measure taken and being almost unanimous among researchers, public sector and producers is the sanitary void of soybeans, which was established by legislation as a defined and continuous period in which one cannot sothe or maintain live plants of a plant species in a given area, with the aim of reducing the inoculum of diseases or population of a given pest, as stated in Ordinance No. 306 of May 13, 2021 [41].

One of the paradigms of phytopathology is the disease triangle, in which the conditions for a disease to settle are formed: susceptible host, virulent pathogen and favorable environment. And by eliminating one of these components, the disease cannot settle. The logic of the sanitary void is to make the establishment of the disease unfeasible due to the lack of host, since the interaction of pathogen, host and environment factors is essential for the occurrence of diseases in plants [42].

This is the biological basis for the adoption of the sanitary void of soybeans, which is a mandatory and very effective management measure, which prohibits soybean planting for a period of 60 to 90 days and requires the eradication of guaxs soybean plants, or spontaneous growth, whether in the crop, on the roadside, preventing or minimizing "green bridges". However, in the case of this sanitary measure, it must be respected collectively. If a farmer does not respect the sanitary void of soybeans, it can endanger the health of neighboring crops. Another important consequence of the sanitary void of soybean is the reduction of the possibility of selection of p. pachyrhizi populations resistant to fungicides available in the market.

The occurrence of Asian rust in the 2005/2006 crop, which had a great economic impact on the soybean production chain, promoted or stimulated efforts for the participants of the chain to promote discussions to mitigate the impacts of the fungus on crops, which worsened each crop.

Thus, the implementation of measures to prevent and control Asian soybean rust in the State of Mato Grosso do Sul began to be discussed on May 4, 2006, when a rural union meeting of Chapadão do Sul was held with the presence of about 70 participants among producers, technicians and researchers, together with representatives of IAGRO. Similar meeting took place in the municipality of Maracaju. It was the beginnings of state legislation that is the basis for prevention, control and eradication of Asian Soybean Rust in Mato Grosso do Sul, which has been described earlier, whose initial landmark was State Law No. 3.333.333.

At the time the law came into force, to clarify producers about the new legal requirements, the Health Education Division, together with the Division of Plant Sanitary Defense and in partnership with rural unions and inPEV - National Institute of Empty Packaging Processing, held a series of lectures for producers, in the main soybean producing regions of the state, to present the new law and the technical foundations that guided the new conducts, the care with the management of the crop that became mandatory and also how the inspections would be carried out and what sanctions would be imputed to producers in case of commit of infractions.

Other states, before the MS, had already adopted the sanitary void of soybeans and others adopted it later, including the neighboring country Paraguay, in 2011, as shown in fig. Six, six.

PA (1): Microregions of Conceição do Araguaia, Redenção, Marabá, São Félix do Xingu, Parauapebas, Itaituba (except for the municipalities of Rurópolis and Trairão) and Altamira (District of Castelo dos Sonhos and Cachoeira da Serra). PA (2): Microregions of Paragominas, Bragantina, Guamá, Tomé-Açu. Salty. Tucuruí, Castanhal. Arari, Belém, Cametá, Boreholes of Breves and Portel. PA (3): Microregions of Santarém, Almeirim, Óbidos, Itaituba (municipalities of Rurópolis and Trairão) and Altamira (except the districts of Castelo de Sonhos and Cachoeira da Serra).

MA (1): Microregions of Alto Mearim and Grajaú: Chapadas do Alto Itapecuru, Chapadas das Mangabeiras; Generals of Balsas, Empress; Porto Franco. MA(2); Microregions of Urban Agglomeration of São Luís; Baixada Maranhense; Lower Parnaíba Maranhense; Boxes; Chapadinha; Codó, Coelho Neto; Gurupi; Itapecuru Mirim; Maranhenses Sheets; Maranhense West Coast; Middle Mearim; Pindaré; President Dutra; Rosary.

Paraguay (1): Eastern Region from 06/01 to 08/30 (Res. nº 071/11). Paraguay (2): Occidental Region from 15/06 to 15/09 (Res. N. 633/17)

Fig. 6: Periods of sanitary vacuum in Brazilian states and Paraguay, established by regulations in their respective phytosanitary defense agencies. Source: Embrapa, 2020

During the period of the soybean sanitary void (June 15 to September 15) IAGRO inspectors make visits to rural properties in order to inspect the cultivation area and other adjacent areas regarding the destruction of soybean crop residues (raccoon, rebolded or planting).

This worksees you as objective to characterize the health defense actions carried out by IAGRO regarding the supervision and application of legislation that deals with the sanitary void of soybeans aiming at maintaining the control of Asian rust in the State of Mato Grosso do Sul.

II. MATERIAL AND METHODS

a) Research Design

In this work, a survey of the supervisory actions of the state agricultural inspectors agronomists of IAGRO related to the conduct of activities to control Asian soybean rust in

the State of Mato Grosso do Sul was carried out. Data were searched for the period from 2006 to 2021, both in the former Phoenix system and in the current one, e-Saniagro.

Data were used regarding fines for lack of registration, for non-control of plants and due to planting during the period of the sanitary void. It was also determined the number of participants and the number of Socio-educational Seminars held for lack of registration of soybean plantation, soybean planting areas registered, areas inspected in the harvests and amount of infringement notices drawn up each period of inspection of the sanitary void are stored in the computerized systems of IAGRO.

b) Data collection at IAGRO

The State Agricultural Inspectors (FEA) - agronomists carry out annually, during the sanitary void of soybeans, on-site inspections in soybean producing properties in order to ensure compliance with the legislation for the control of the disease.

Inspections are based on planning according to the data obtained from the registration of soybean plantations (required by law) for the current crop. From the listing of registered properties, the FEA responsible, after thorough analysis, plans with the IAGRO coordination the field inspection actions. In the inspections, it is verified whether the producer has fulfilled the soybean void period, with the destruction of irregular plantings, or of plants that were born spontaneously from grains lost during harvest or transport.

The quantitative execution of inspections is based on the resources made available through a federal agreement with MAPA and resources of the Government of the State of Mato Grosso do Sul. The amount of resources available is adjusted together with the IAGRO board server team.

In case of non-compliance with current legislation, penalties are applied according to the violation observed. Cash penalties are fixed in the State Reference Tax Unit of Mato Grosso do Sul - UFERMS, whose value is indexed in national currency (Reais) and is often adjusted. Table 1 presents the value in UFERMS corresponding to the main infractions to the legislation of the sanitary void of soybeans.

Table 1: Violations of the Law of The Sanitary Void of Soy and amount of the fine. Source: e-Saniagro, IAGRO/MS

Violations of the Soy Sanitary Void Law and corresponding penalties	
Infraction	**Basic amount of fine in UFERMS**
Lack of registration of the planting area	100 UFERMS
Non-disposal of raccoon plants	200 UFERMS
Non-compliance with the sowing schedule, with graduation according to size of irregular area	200 UFERMS
Not performing any type of disease control	400 UFERMS
Soybean planting in succession to soybean (safrinha) with graduation according to irregular area size	1000 UFERMS
Planting during the period of the sanitary void	1000 UFERMS
Value of UFERMS in November 2021: R$42.56	

The inspection reports feed IAGRO's data storage systems, along with the mandatory registrations made by the producers, informing the planting areas that they will carry out in the current harvest. With the evolution of the system, the data stored between 2009 and March/2017 (Fênix System) were migrated to the official system database, currently in use, the e-Saniagro.

III. RESULTS AND DISCUSSION

After the implementation of the period of sanitary void and the mandatory registration of planting of soybean areas in the MS, these have been periodically supervised to verify compliance with the legislation. To optimize the actions, several technological tools are used for data analysis, being possible to achieve an optimization of the staff of the servers and a better assertiveness, prediction and resolution of irregularly identified events. The dynamicity, an intrinsic characteristic of agriculture, reinforces the need for constant evolution of legal instruments. The implementation of new legislation causes much resistance and questioning on the part of producers and members of the chain who are affected by the measures.

In order for any implementations or changes in legislation to be disseminated and clarified, with a view to compliance by those involved in the production chain, IAGRO relies on the Health Education Division, which is responsible for preparing and conducting interactive lectures that are held in the field, to clarify producers, develop educational support material, such as folders and flyers, in addition to preparing and disseminating legal deadlines in various communication channels.

To specifically meet the legislation of the Soy Sanitary Void, the Division of Sanitary Education holds socio-educational seminars, composed of two lectures, for the lack of registration of soybean planting areas since the year 2010, and since December 2020, the seminar has been held in the modality of videoconference, due to the pandemic of Covid 19. The fine for failure to register, which is classified as a minor infraction, is 100 UFERMS and can be converted entirely into a socio-educational measure, as stated in Law 3.606/2008. The lectures address the cycle of the fungus of Asian rust, the biological principles for the adoption of the sanitary void, all relevant legislation and the importance of sanitary defense for the country. In all, 664 employees have benefited from registering soybean areas. Table 2 presents the data by municipality where the socio-educational seminars were held.

Table 2. Socio-educational seminars held for employees due to lack of registration.

Des/DDSV Socio-Educational Seminar				
Plant Sanitary Defense and Soybean Sanitary Void Law				
#1	**Municipality**	**Date**	**Number of Participants**	**Total**
First	Campo Grande	17.12.2010	39	39
2nd	Campo Grande	12.06.2011	63	63
Third	Campo Grande	1st.12.2011	7	40
	Golden	02.12.2011	33	
4th	Campo Grande	26.04.2012	22	86
	Golden		36	
	New Andradina		17	
	Ponta Porã		11	
5th	Campo Grande	06.12.2012	12	56
	Costa Rica		6	
	Cushion		1	
	Golden		19	
	New Andradina		3	
	Ponta Porã		15	
6th	Campo Grande	28.11.2014	16	41
	Costa Rica		3	
	Golden		18	
	New Andradina		4	
7th	Campo Grande	18.03.2016	22	26
	New Andradina		4	
8th	Campo Grande	18.11.2016	38	74
	Costa Rica		5	

	Golden		20	
	Naviri		3	
	New Andradina		8	
9th	Campo Grande	08.06.2017	9	33
	Cushion		3	
	Golden		10	
	Naviri		1	
	New Andradina		10	
10th	Campo Grande	07.12.2017	7	19
	Costa Rica		1	
	Golden		4	
	Naviri		3	
	New Andradina		4	
11th	Campo Grande	08.06.2018	9	28
	Costa Rica		4	
	Golden		6	
	Naviri		1	
	New Andradina		7	
	Ponta Porã		1	
12th	Campo Grande	06.12.2018	26	60
	Golden		19	
	N. Andradina		15	
13th	Campo Grande	14.06.2019	6	23
	Golden		1	
	N. Andradina		16	
14th	Campo Grande	05.12.2020	7	18
	Golden		4	
	N. Andradina		7	
15th	Campo Grande - On Line	03.12.2020	14	14
16th	Campo Grande - On Line	19.03.2021	15	15
17th	Campo Grande - On Line	25.08.2021	12	12
18th	Campo Grande - On Line	01.09.2021	17	17
TOTAL				**664**

In thefig. 7 data from estimated planting areas (IBGE), areas registered in IAGRO and inspected areas in the 2006/07 harvests to 2014/15 are demonstrated.

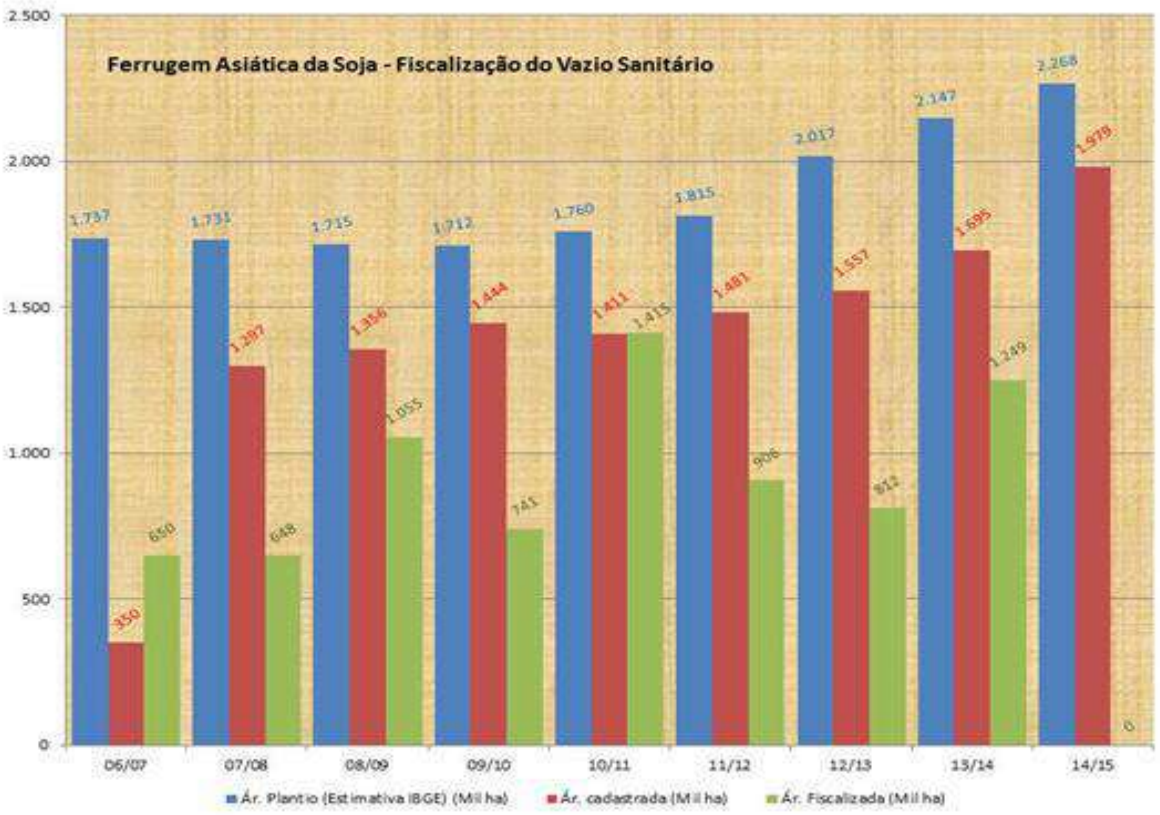

Fig. 7: Estimated planting areas (IBGE), areas registered in IAGRO and areas inspected in the 2006/07 harvests to 2014/15.

Through a survey in the IAGRO database, from 2009 on, it was observed that, after the entry into force of the Soybean Sanitary Void Law and the inspection activities of the planting areas, soybean crops during the lifetime of the sanitary void were few. In addition to having been widely disseminated the legislation in the media, at the time of its entry into force, lectures were also held to clarify the new legal requirements and on the biological foundations for the empty sanitary adoption. Thefig. 8 shows the number of assessments that occurred during the 2009/10 harvests until 2020/21. The largest amount was due to the lack of registration of soybean planting areas, and in the 2020/21 crop there was an increase of 177% in the cases. This may be related to the fact that there was an increase in the planted area of soybean, with even in regions that had livestock as the main activity [1], in this case, producers beginning in the activity, may not have knowledge about the legal requirement to register the areas. It is observed that there were few assessments for non-compliance with the sanitary void, and there was an increase in the 2014/15 crop and then 5 cases in the 2019/20 crop, There was also an increase in the occurrence of fines for not controlling raccoon plants in the 2017/18 crop, followed by two harvests with this fall parameter and a new increase in the 2019/20 20 2020/21 harvests. As for fines for lack of chemical, biological or mechanical control of soybean rust already installed, in this period analyzed, there were only 4 assessments.

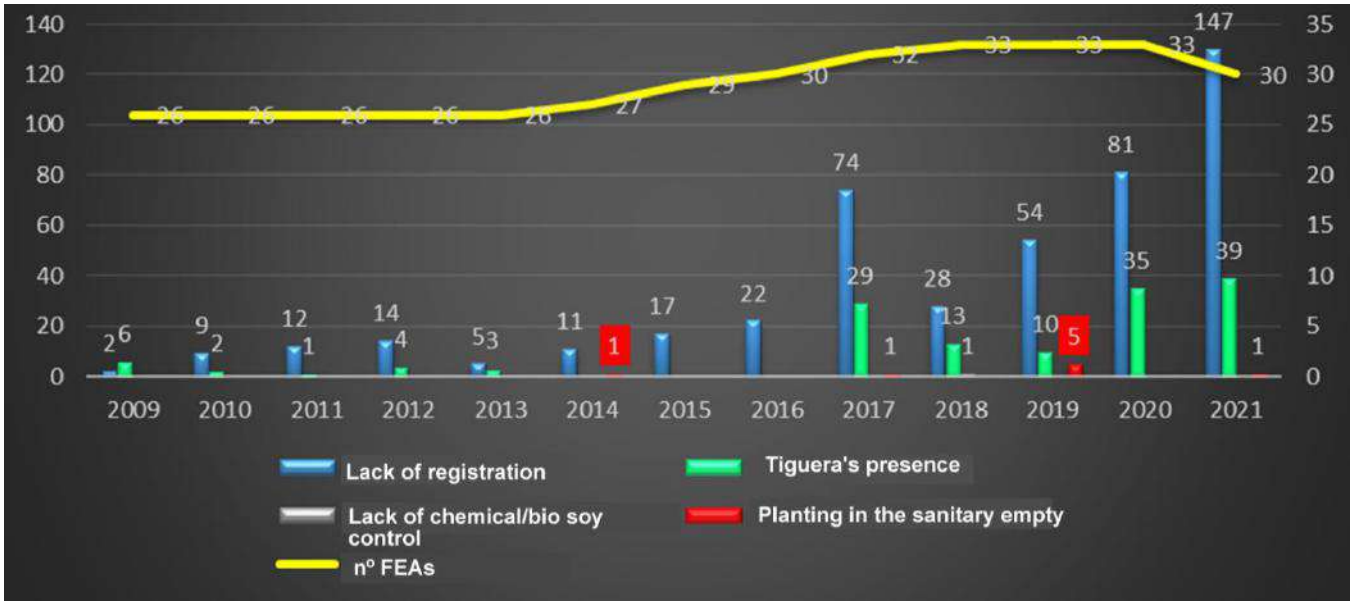

Fig. 8: Infraction notices in the 2009/07 to 2020/21 harvests. Source: e-Saniagro/IAGRO.

In relation to the inspectors who act to curb the non-compliance with the sanitary legislation, from the year 2020, there was a reduction in the number of staff, which may cause some difficulty to meet the inspection targets, if the trend of increase in soybean areas in the state of Mato Grosso do Sul persists.

IV. CONCLUSION

In the state's production matrix, soybean cultivation has become a master activity of the South Mato Grosso economy due to its connection with the industrial sector and partly with the service sector. Thus, negative variations in productivity may affect the state's production chain and economy.

Given IAGRO's history of action in the last 20 years, in the face of Asian soybean rust, it is known that its control permeates the work carried out by IAGRO in promulgating competent legislation.

An essential factor for compliance with the legislation is in the work carried out by the Agronomists and Technicians FEAs. Therefore, the decrease in servers due to retirements, medical leave and other factors will increase the risk for maintaining the control status achieved, and consequently, the improvement of IAGRO's actions.

Although we have specific laws at the national and state level to control soybean rust, such as the soybean planting schedule and also the strict control of inspections carried out by IAGRO, it was necessary to implement the prohibition of the planting of soybeans in second harvest, in succession to soybean, in the same area and in the same agricultural year. Even with all preventive measures and with farmers having already become aware that this period of sanitary vacuum must be respected, all care is not sufficient, because this pathology has as characteristic the propagation through the action of air currents and even if excellent management is carried out in the off-season, it will still occur, with greater or lesser intensity, depending on weather conditions.

All this is reason to further promote the actions of awareness of producers, through educational actions and thus giving support to the strict control made by inspection actions, after all, the aim is to maintain the sanity of our crops, the safety of the food we produce and safeguard the market, since soybeans is a product with great importance for the economy of the state and Brazil.

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The harmonic and melodic connection numbers involving the mutual inclusions among the generic groups of notes arbitrarily emitted

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***Keywords*— Chords, Harmonic substitutions, Harmonization, Scales, Unconventional Notation.**

***Abstract*—** *The present paper is aimed to provide specific details and new results related to the music network described in the previous study by the author. While the first paper served as an introduction and extensive analysis of the model in all its potential applications, the present study is aimed at providing supplementary data to quantitatively support the previous one. The music concepts described in the present paper concern the evaluation of all the potential mutual inclusions and connections among chords, scales, and more in general any generic group of notes arbitrarily played by each musician. These concepts characterize the specific algorithm purposely developed and implemented in an interactive software application tool that can be employed for performing the melodic and harmonic analyses of any kind of tune. Geometric music graphs that take into account these groups are automatically designed by the software in order to trace the harmonic and melodic zones touched by each music composition. These geometric graphs are constituted by the connections (that can also represent mutual inclusions) among the generic groups of notes. The primary focus of the present paper is on the quantitative results and data characterizing the inner structure related to these graphs.*

I. INTRODUCTION

The music network and the related concept can be chosen as the suitable model to describe the mutual relationships and inclusions among generic groups of notes (and related frequencies). Notes, scales and chords provide the melodic and harmonic resources to which each musician is inevitably addressed for the composition process. Each of these elements is characterized by its specific sound. Any generic group of notes (constituted by 1 up to 12 notes) can be considered pertaining to one or more scales and chords that are the melodic and harmonic subgroups in which the set of 12 notes is organized. Studies related to this research field are those of [1, 2, 3, 4, 5, 6, 7]. It is of interest to highlight the studies of Cataldo [8, 9, 10] who developed an innovative transformations method of harmonic progression by employing advanced harmonic substitutions in order to introduce a new formalism related to Music Algebra incorporating concepts derived by [11, 12, 13, 14, 15, 16, 17]. The present study and the related methodological approach fit into this line of research. The present study is the natural completion of the author's previous study [18] in which the method related to the graphical view of the music network and the related nodes has been introduced and extensively described. In some terms, scales and chords can be thought as the result of an iterative process through “trials and errors” aimed to identify the melodic and harmonic

subgroups in which the set of 12 notes is organized. As the defined scales and chords are employed, they instantaneously reduce the number of attempts, minimizing the number of "trials and errors". As explained in detail in the previous study [18], the specific algorithm implemented in the calculation program allows to trace the connections among groups of notes arbitrarily played in real-time (or typed on a pc-keyboard) by the musician and mapping harmonic and melodic movements on 2D music network graphs that can also be considered as 3D music solid network graphs. Each node represents a specific musical scale or a specific chord, more in general any generic group of notes arbitrarily played. The system is not dependent on the instrument played by the musician, representing a synthesized geometric view (divisible into different sub-networks) of all possible interconnections and mutual inclusions among different generic groups of notes and the related frequencies arbitrarily considered by each musician (the shape and extension of the entire music network depend on the number of generic groups of notes considered by the musician, thus on the subjective degree of knowledge of the musician who will enrich his graphic-musical network in the learning process). Each chord is considered as generated by specific degrees of different scales as well as an autonomous entity (a generic group of notes) and completely unrelated to one (or more) specific scale. The generic groups of one up to twelve notes are interconnected by following a parsimonious voice-leading approach as explained in detail in [18]. Each scale is considered as a container of chords since each scale is like a big chord that can be subdivided into its singular components that are the chords. Even if the scales did not exist and only notes and generic groups of notes (i.e. chords or equivalently the related arpeggios of three, four, maximum five notes) were assumed to exist autonomously, it is possible to reasonably arrange them and reconstruct the harmonizations and also the fingerings of many different scales (that share those specific chords and related arpeggios) in any case, thus employing a relatively low number of elements. Chords and scales constituted by the same or a different number of notes can be harmonically and melodically interconnected. To this aim, the *harmonic connection degree number*, the *real harmonic connection degree number* and the *melodic connection degree number*, whose definitions are reported in [18], have been suitably introduced and quantitatively reported in the present paper. The connections among chords and scales are represented by the connections lines whose colors are those proper of the connected scales and chords that in turn are represented in a condensed/synthetic manner through the use of different symbols (markers) and colors as described and shown in [18]. Chords and scales constituted by a different number of notes can also be mutually included (i.e. each chord and each scale can be included in other chords and other scales having a higher number of notes) as reported and shown in the following sections of the present paper. The focus of the present paper is on the following points related to the software in which the method is implemented:

- Different input settings of the software can be set by the user musician in order to choose the environment of scales and chords to be considered and handled by the process. Different examples have been reported in the present paper, included some preliminary analyses related to the input setting scales defined by [7].

- Detailed lists reporting the *melodic connection degree number* related to each scale or chord are provided. The *melodic connection degree number* univocally represents the melodic connection's level between different scales.

- The harmonization starting from each degree of each considered scale or chord is automatically computed by the software and provided in the present paper. The main chords constituted by three and four notes defined and reported in [18] are primarily considered in the present paper.

- Detailed lists reporting the *harmonic connection degree number*, and the *real harmonic connection degree number* related to a specific scale or a specific chord are provided (as examples). As reported in [18], for the determination of the *harmonic connection degree number* the main chords of three and four notes can be employed, while all the *basic chords* are strictly needed to determine the *real harmonic connection degree number*. A *basic chord* is a chord type constituted at least by two and a maximum of three notes. The *basic chords* are not explicitly presented but only used and reported in the text as background information. The *real harmonic connection degree number* univocally represents the real harmonic connection's level between different scales. From these analyses, it is also possible to underline all the chords which do not allow a harmonic connection among the scales chosen by the user. These chords are not in common between scales since they are specific and proper of a specific scale besides of course the *12 notes chromatic scale.*

- Since each scale and each chord can be included by other bigger scales and chords if all the notes of the smaller scale and smaller chord are in common with the bigger ones, the list of the scales and chords included by each scale type and each chord type is provided by the software and reported in the present paper. Furthermore,

the list of the scales and chords in which each scale type and each chord type is included is provided.

- Scales and chords which include a single or a generic group of single notes chosen/played by the user are provided by the software and reported in the lists.

- Scales and chords which include a single or a generic group of chords chosen/played by the user are provided by the software and reported in the lists.

- Chords (and also scales) that are equal but have different names can be suitably employed for defining new perspectives in the music network graphs application, specifically for what concerns the inversion substitutions in case of chords and rotations of the main scale in case of scales.

- New perspectives for what concerns music improvisation can be experimented employing the geometrical-based approach that constitutes the music network graphs. In particular, it can be demonstrated how following the trajectories traced by the parsimonious voice-leading approach to connect generic groups of notes (scales and chords) can provide a human ear-friendly response.

- Further examples of the graphic and time-dependent network constituted by the considered chords and scales which are melodically connected since similar in terms of common notes have been provided by means of some scales related to the *Modes of limited transposition* [6].

II. INTERVAL NOTATION AND GENERAL CONVENTIONS

The definition of the notes and intervals is primarily needed in order to define the different music scale and chord types and the related structures reported in detail in [18]. In particular, it is important to introduce the *12 notes chromatic scale* from which all the other scales and chords are originated and included. This scale is comprehensive of all the 12 notes of the equal temperament system; its structure is based on a series of 12 semitones (all its constituting notes are separated from each other by a minor second interval). Since this scale includes all the 12 notes, it is not characterized by any specific starting note (which is in some cases known also as the tonic of the scale and denoted by number 1, as the first degree of the scale). Each of the 12 notes can be equivalently considered and assumed as the starting note (first degree) of the scale. As a consequence, this scale is not capable of generating any *mode* (except the one denoted by the proper structure of the scale itself) since the intervals structure remains the same regardless of the starting note chosen. It has to be specified that a *mode* is a rotation of the same considered scale obtained by assuming each of their constituting note as the first degree of the scale (the scale is the same, the *modes* related to the scale are obtained by considering all the possible rotations of that scale which assumes a different first-degree note for each generated *mode*). The same concept applies for the chord *inversions* that are characterized by having a constituting chord note, which is different from the fundamental, placed as the bass note. Each chord *inversion* is constituted by the same notes of the original chord despite a different name. Each chord *inversion* of a chord can be of the same family related to the original chord or not. It has to be noted that all the music intervals can be defined according to the chosen starting note of the *12 notes chromatic scale*. For instance, it is possible to choose the *C* note as the starting note (denoted by number 1) of the chromatic scale thus referring all its constitutive intervals to *C* (the chosen starting note could be any note different from *C* while the related interval names remain the same). The structure of the *12 notes chromatic scale* in terms of intervals has been proposed in Table 1. All the intervals are referred to the chosen starting note (1, in this case, is the *C* note):

Table.1: Structure of the 12 notes chromatic scale in terms of interval related to the chosen starting note (1)

Notes names of the *12 notes chromatic scale* (as referred to the *C* starting note):
C=(B#), Db=C#, D, D#=Eb, E=(Fb), F=(E#), F#=Gb, G, G#=Ab, A=(Bbb), Bb=A#, B=(Cb)
Constitutive intervals of the *12 notes chromatic scale* referred to the chosen starting note (1):
1 or 8 or (7#), 2b or (1#), 2, 2# or 3b, 3 or (4b), 4 or (3#), 4# or 5b, 5, 5# or 6b, 6 or (7bb), 7b or (6#), 7 or (8b)

The notes' names of the *12 notes chromatic scale* are reported in the first line of Table 1, while its constitutive intervals are reported in the second line. The "*or*" symbol denotes the possible alternatives that can be used in order to achieve a diesis # and flat *b* parsimonious use. The less-used notes names and related intervals (referred to 1) are reported inside the brackets "*()*". These last names are conventionally existent and used only in some specific cases. The intervals are identified by numbers (the number 1 identifies the starting note, the so-called tonic or first-degree of the scale, or the fundamental of the chord) and their names are reported in Nomenclature. The scale types (and the related *modes*) considered in the present study and the related structures in terms of intervals related to their first degree are those reported in [18] and [7]. Some

properties related to the transposition within an octave of each considered scale are summarized in Table 2.

Table.2: Some properties related to each scale type considered and reported by [18] and [7].

Scale type	***Is the transposition within an octave possible?***	***Number of scales and related first degrees within an octave***	***Number of modes inner to the scale within an octave***
Major scale (ionian mode) ([18], [7])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*7*
Melodic minor scale ([18], [7])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*7*
Harmonic minor scale ([18], [7])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*7*
6 notes blues scale ([18])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*6*
Whole-tone scale ([18], [7])	*Yes*	*2; C, C#*	*1*
Half-step/whole step diminished scale ([18], [7])	*Yes*	*1; C*	*2*
Whole step/half-step diminished scale ([18], [7])	*Yes*	*2; C, D*	*2*
Augmented half-step minor-third scale ([18])	*Yes*	*2; C, D*	*2*
Augmented minor-third half-step scale ([18])	*Yes*	*2; C, D*	*2*
Messiaen mode #3 (Rotation 1) ([18], [7])	*Yes*	*4; C, C#, D, Eb*	*3*
12 notes chromatic ([18])	*No*	*1; C*	*1*
Harmonic major scale ([18], [7])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*7*
Bebop major scale ([18], [7])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*8*
Harmonic minor scale+6 notes blues scale ([18], [7])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*9*
Bebop dominant scale ([18], [7])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*8*
Melodic minor scale+Dorian scale ([18], [7])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*8*
Melodic minor scale+ Harmonic minor scale ([18], [7])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*8*
Melodic minor scale+4# ([18], [7])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*8*
Melodic minor scale+Mixolydian scale ([18], [7])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*9*
Minor pentatonic scale+3+6 ([18], [7])	*Yes*	*12; C, C#, D, Eb, E, F, F#, G, Ab, A, Bb, B*	*7*

Many other typologies of scales exist. For the sake of brevity, they are not reported in the present study. The scales incorporate, therefore generate different types of chords. The main chords of three and four notes defined in [18] are primarily considered in the present study. The *basic chords* are defined in [18] and reported in the text as background information.

2.1 SCALES HARMONIZATIONS AND MUTUAL INCLUSIONS

The harmonizations of the scales presented in [18] are reported in Table 3 by means of the main chords constituted by three and four notes defined in [18]. The *C* note is chosen as the first degree of each scale in order to have a common reference to distinguish and highlight the differences among the scales in terms of structure. For the sake of brevity, the harmonizations of the scale types specifically considered by [7] have not been reported.

Table.3: Scales harmonizations by means of the main chords of three and four notes defined in [18].

***C Ionian**:C D E F G A B*
Cmaj Cadd9 Cadd4 C6 Cmaj7 Dm Dm/add9 Dm/add4 Dm6 Dm7 Em Em/add9b Em/add4 Em7 F5b Fmaj Fadd9 Fadd4# Fmaj7/5b F6 Fmaj7 Gmaj Gadd9 Gadd4 G6 G7 Am Am/add9 Am/add4 Am7 Bdim Bdim/add4 Bm7/5b
***C Melodic minor**:C D Eb F G A B*
Cm Cm/add9 Cm/add4 Cm6 Cm/maj7 Dm Dm/add9b Dm/add4 Dm6 Dm7 Eb5b Eb5# Ebmaj7/5b Ebmaj7/5# F5b Fmaj Fadd9 Fadd4# F7/5b F6 F7 Gmaj G5# Gadd9 Gadd4 G7 G7/5# Adim Adim/add4 Am7/5b Bdim B5b B5# B5b/add9b Bm7/5b B7/5b B7/5#
***C Harmonic minor**: C D Eb F G Ab B*
Cm Cm/add9 Cm/add4 Cm/maj7 Cm/maj7/5# Ddim Ddim/add4 Ddim7 Dm7/5b Eb5# Ebmaj7/5# Fdim Fm Fm/add9 Fm/add4# Fdim7 Fm7/5b Fm6 Fm7 Gmaj G5# Gadd9b Gadd4 G7 G7/5# Abdim Abm Ab5b Abmaj Abm/add4b Abm/add4# Abdim7 Abm/maj7/5b Abm6 Abm/maj7 Abadd4# Abmaj7/5b Ab6 Abmaj7 Bdim B5b B5# B5b/add9b Bdim7
***C 6 notes blues**: C Eb F F# G Bb*
Cdim Cm Cdim/add4 Cm/add4 Cm/add4# Cm7/5b Cm7 Ebm Ebmaj Ebm/add9 Ebadd9 Ebm/add4b Ebm6 Eb6 F#5b F#5b/add9b F#maj7/5b Gm/maj7/5#
***C Whole-tone**: C D E F# G# Bb*
C5b C5# C7/5b C7/5# ; the same harmonization order applies for the tones related to D E F# G# Bb
***C Half-step/whole step diminished**:*
C Db Eb E Gb G A Bb
Cdim Cm C5b Cmaj Cm/add9b C5b/add9b Cadd9b Cm/add4b Cm/add4# Cdim7 Cm7/5b Cm6 Cm7 Cadd4# C7/5b C6 C7 Dbdim Dbdim/add4 Dbdim7 Dbm/maj7/5b Dbm/maj7/5# ; the same harmonization order applies for the tones related to Eb E Gb G A Bb
***C Whole step/half-step diminished**:* *C D Eb F Gb G# A B*
Cdim Cdim/add4 Cdim7 Cm/maj7/5b Cm/maj7/5# Ddim Dm D5b Dmaj Dm/add9b D5b/add9b Dadd9b Dm/add4b Dm/add4# Ddim7 Dm7/5b Dm6 Dm7 Dadd4# D7/5b D6 D7 ; the same harmonization order applies for the tones related to Eb F Gb G# A B
***C Augmented half-step minor-third**: C Db E F G# A*
C5# Dbm Dbmaj Db5# Dbm/add4b Dbm/maj7 Dbm/maj7/5# Dbmaj7 Dbmaj7/5# ; the same harmonization order applies for the tones related to E F G# A
***C Augmented minor-third half-step**: C Eb E G G# B*
Cm Cmaj C5# Cm/add4b Cm/maj7 Cm/maj7/5# Cmaj7 Cmaj7/5# Eb5# ; the same harmonization order applies for the tones related to E G G# B
***C Messiaen mode #3 (Rotation 1)**:* *C Db D E F F# G# A Bb*
C5b C5# C5b/add9b C5b/add4 C7/5b C7/5# Dbm Dbmaj Db5# Dbm/add9b Dbadd9b Dbm/add4b Dbm/add4 Dbm6 Dbm/maj7 Dbm/maj7/5# Dbadd4 Db6 Dbmaj7 Dbmaj7/5# Ddim Dm D5b Dmaj D5# Dm/add9 Dadd9 Dm/add4b Dm/add4# Dm7/5b Dm/maj7/5b Dm7 Dm/maj7 Dm/maj7/5# Dadd4# D7/5b Dmaj7/5b D7 Dmaj7 D7/5# Dmaj7/5# ; the same harmonization order applies for the tones related to E F F# G# A Bb
***C 12 notes chromatic**: C Db D Eb E F Gb G G# A Bb B*
Cdim Cm C5b Cmaj C5# Cm/add9b C5b/add9b Cadd9b Cm/add9 Cadd9 Cm/add4b Cdim/add4 Cm/add4 Cm/add4# Cdim7 Cm7/5b Cm/maj7/5b Cm6 Cm7 Cm/maj7 Cm/maj7/5# C5b/add4 Cadd4 Cadd4# C7/5b Cmaj7/5b C6 C7 Cmaj7 C7/5# Cmaj7/5# ; the same harmonization order applies for the tones related to Db D Eb E F Gb G G# A Bb B

It has to be specified that the scales and chords considered in the present Section are all included in the *12 notes chromatic scale*. Focusing on the scales, there are no further mutual inclusions among the other scales considered (*12 notes chromatic scale* excluded). The *minor pentatonic* scale is considered as an extra-scale

among those primarily considered in the present study. The structure related to the *minor pentatonic* scale in terms of intervals related to its first degree is *1 3b 4 5 7b*. For instance, the *C minor pentatonic* scale is constituted by the notes: *C Eb F G Bb*. The *C minor pentatonic* scale generates the *Eb6/9* chord on its third degree (its third degree is denoted by the name *Eb major pentatonic* scale or the *first pentatonic mode* that corresponds to the *Eb6/9* chord arpeggio). When the *minor pentatonic (*also known as the *fifth pentatonic mode)* scale is considered, mutual inclusions among the scales considered in the present Section turn out. It has to be specified that in general, among the general properties explained in detail in [18], when mutual inclusions between two different sets A and B (each constituted by a certain number of elements, i.e. A can have the same or a different number of elements of B) turn out, the following relationships are satisfied:

A+B=A if B already included in A (1)

A+B=B if A is already included in B (2)

(A+B)-B=E if A and B share some or have all the elements in common (3)

(A+B)-A=F if A and B share some or have all the elements in common (4)

A-B=D if A and B share some or have all the elements in common (5)

(A-B)-B=D-B if A and B share some or have all the elements in common (6)

(A-B)-A=D-A if A and B share some or have all the elements in common (7)

(A-B)-B=A-B if B already included in A (8)

(B-A)-A=B-A if A already included in B (9)

These mutual inclusions among the scales are reported in Table 4. The *C* note is chosen as the first degree of each scale.

Table.4: Mutual inclusions among the scales considered in the present Section when the minor pentatonic scale is introduced.

Scale type	***Scales included by the scale type***	***Scales in which the scale type is included***
C Ionian	*D minor pentatonic, E minor pentatonic, A minor pentatonic*	*C 12 notes chromatic*
C Melodic minor	*D minor pentatonic*	*C 12 notes chromatic*
C Harmonic minor	*None*	*C 12 notes chromatic*
C 6 notes blues	*C minor pentatonic*	*C 12 notes chromatic*
C Whole-tone	*None*	*C 12 notes chromatic, C Messiaen mode #3 (Rotation 1), D Messiaen mode #3 (Rotation 1)*
C Half-step/whole step diminished	*None*	*C 12 notes chromatic*
C Whole step/half-step diminished	*None*	*C 12 notes chromatic*
C Augmented half-step minor-third	*None*	*C 12 notes chromatic, C Messiaen mode #3 (Rotation 1), Eb Messiaen mode #3 (Rotation 1)*
C Augmented minor-third half-step	*None*	*C 12 notes chromatic, D Messiaen mode #3 (Rotation 1), Eb Messiaen mode #3 (Rotation 1)*
C Messiaen mode #3 (Rotation 1)	*C Whole-tone, C Augmented half-step minor-third, D Augmented minor-third half-step*	*C 12 notes chromatic*
C minor pentatonic	*None*	*C 12 notes chromatic, C 6 notes blues, Bb Melodic minor, Eb Ionian, Ab Ionian, Bb Ionian*
C 12 notes chromatic	*All*	*None*

The same investigation about the mutual inclusions among different sets of notes has been made for all the main chords constituted by three and four notes considered in the present study. This investigation is reported in Table 5. Please notice how the investigation reported in Table 4 does not involve the chords, as well as the one in Table 5 does not involve scales despite chords and scales can be considered as generic groups of notes, thus legitimately directly compared and, if similar [18], interconnected (also mutually included very often). The *C* note is chosen as the fundamental of each chord.

Table.5: Mutual inclusions among the main chords of three and four notes considered in the present study.

Chord type	***Chords included by the chord type***	***Chords in which the chord type is included***
Cdim	*None*	*Badd9b, Cdimadd4, Cmadd4#, Cdim7, Cm7/5b, Ab7*
Cm	*None*	*Cmaddb9, Cmadd9, Cmadd4b, Cmadd4, Cmadd4#, Am7/5b, Cm7, Cm/maj7, Abmaj7*
C5b	*None*	*C5badd9b, F#m7/5b, C5badd4, Cadd4#, C7/5b, Cmaj7/5b, Ab7/5#*
Cmaj	*None*	*Cadd9b, Cadd9, Cmadd4b, Am7, Cadd4, Cadd4#, C7, Cmaj7, Abmaj7/5#*
C5#=E5#=G#5#	*None*	*C#m/maj7, Fm/maj7, Am/maj7, C7/5#, E7/5#, G#7/5#, Cmaj7/5#, Emaj7/5#, G#maj7/5#*
Cm/add9b	*Cm*	*None*
C5b/add9b	*C5b*	*None*
Cm/add9	*Cm*	*None*
Cadd9	*Cmaj*	*None*
Cdim/add4	*Cdim*	*None*
Cm/add4	*Cm*	*None*
Cm/add4#	*Cdim, Cm*	*None*
Cdim7=Ebdim7= =Gbdim7= Adim7	*Cdim, Ebdim, F#dim, Adim*	*None*
Cm7/5b = Ebm6	*Cdim, Ebm, F#5b*	*None*
Cm/maj7/5b=Badd9b	*Cdim, Bmaj*	*None*
Cm7 = Eb6	*Cm, Ebmaj*	*None*
Cm/maj7	*Cm, Eb5#*	*None*
Cm/maj7/5#=Abm/add4b	*Abm, Abmaj*	*None*
C5b/add4	*C5b*	*None*
Cadd4	*Cmaj*	*None*
Cadd4#	*C5b, Cmaj*	*None*
C7/5b = Gb7/5b	*C5b, Gb5b*	*None*
Cmaj7/5b	*C5b*	*None*
C7	*Edim, Cmaj*	*None*
Cmaj7	*Em, Cmaj*	*None*
C7/5#	*E5b, C5#*	*None*
Cmaj7/5#	*Emaj, C5#*	*None*

It has to be specified that the *minor pentatonic* scale is considered in some of the following investigations (like the one reported in Table 6). In Table 6 some examples of scales that can be employed over chords are reported according to the property that has been found out in [18], which is reinforced here:

- scales (more in general generic groups of notes) that do not generate/include the target chord can, in general, be employed over the target chord together with some of the scales in which they are included into only if the containing (bigger) scales generate/include the target chord.

Table.6: Some examples of scales that can be employed over chords.

Target chord	***Scales that can be employed over the chord given***
F6/9/add4#	*C 12 notes chromatic **then all**; C Ionian, C Melodic minor **then** D minor pentatonic, E minor pentatonic, A minor pentatonic; C Harmonic minor*
Dm7/6/add4	*C 12 notes chromatic **then all**; C Ionian, C Melodic minor **then** D minor pentatonic, E minor pentatonic, A minor pentatonic*
G7	*C 12 notes chromatic **then all**; C Ionian, C Melodic minor, D Melodic minor **then** D minor pentatonic; E minor pentatonic; A minor pentatonic; C Harmonic minor; D Whole step/half-step diminished; C# Messiaen mode #3 (Rotation 1) **then** C# Whole-tone, D Augmented half-step minor-third, D Augmented minor-third half-step*
Eb6/9	*C 12 notes chromatic **then all**; Eb Ionian, Ab Ionian, Bb Ionian, Bb Melodic minor, C 6 notes blues **then** C minor pentatonic, D minor pentatonic, F minor pentatonic, G minor pentatonic, Bb minor pentatonic*
Abmaj7	*C 12 notes chromatic **then all**; Eb Ionian, Ab Ionian **then** C minor pentatonic, F minor pentatonic, G minor pentatonic, Bb minor pentatonic; C Harmonic minor; C Augmented minor-third half-step; D Messiaen mode #3 (Rotation 1) **then** C Whole-tone, D Augmented half-step minor-third; Eb Messiaen mode #3 (Rotation 1) **then** C# Whole-tone, C Augmented half-step minor-third*
Bm7/5b	*C 12 notes chromatic **then all**; C Ionian, C Melodic minor, D Melodic minor, B 6 notes blues **then** B minor pentatonic, D minor pentatonic, E minor pentatonic, A minor pentatonic; A Harmonic minor; F# Harmonic minor; C Whole step/half-step diminished; C# Messiaen mode #3 (Rotation 1) **then** C# Whole-tone, D Augmented half-step minor-third, D Augmented minor-third half-step*
Dm7	*C 12 notes chromatic **then all**; C Ionian, F Ionian, Bb Ionian, C Melodic minor, D 6 notes blues **then** C minor pentatonic, D minor pentatonic, E minor pentatonic, G minor pentatonic, A minor pentatonic; A Harmonic minor; C Whole step/half-step diminished; C Messiaen mode #3 (Rotation 1) **then** C Whole-tone, C Augmented half-step minor-third, D Augmented minor-third half-step*
Dm	*C 12 notes chromatic **then all**; C Ionian, F Ionian, Bb Ionian, C Melodic minor, D Melodic minor, D 6 notes blues, B 6 notes blues **then** C minor pentatonic, D minor pentatonic, E minor pentatonic, G minor pentatonic, A minor pentatonic, B minor pentatonic; D Harmonic minor; F# Harmonic minor; A Harmonic minor; C Whole step/half-step diminished; C Messiaen mode #3 (Rotation 1) **then** C Whole-tone, C Augmented half-step minor-third, D Augmented minor-third half-step; C# Messiaen mode #3 (Rotation 1) **then** C# Whole-tone, D Augmented half-step minor-third, D Augmented minor-third half-step; D Augmented minor-third half-step*
Cm/maj7	*C 12 notes chromatic **then all**; C Melodic minor **then** D minor pentatonic; C Harmonic minor; E Harmonic minor; D Messiaen mode #3 (Rotation 1) **then** C Whole-tone, D Augmented half-step minor-third, C Augmented minor-third half-step; Eb Messiaen mode #3 (Rotation 1) **then** C# Whole-tone, C Augmented half-step minor-third, C Augmented minor-third half-step; C Augmented minor-third half-step*

Some of the chord types shown in Table 6 not necessarily are the main chords of three and four notes primarily considered in the present study (some of them can be considered as the superposition of two or more main chords of three and four notes). From Table 6 inspection, it is straightforward to notice and underline the following general property, as a consequence of the previously highlighted property (already introduced in [18] and applied in Table 6):

- A scale (or chord arpeggio) can be employed over the chord given (target chord) if directly generates the chord given or if that scale (or chord arpeggio) is included by a bigger scale (one or more) that generates the chord given. In this last case the scale (or chord arpeggio, one or more), being included by a bigger scale (one or more), not necessarily has to directly generate the chord given (the target chord might be generated by the bigger containing scale and not by the included one). Therefore, in this last case, the included scale (or chord arpeggio, one or more), not directly generating the target chord, has a weaker harmonic and melodic connection with the chord given than in the case in which a scale (or chord arpeggio, one or more), even if included by another one (one or more), directly generates the chord given thus also melody patterns more harmonically and melodically connected to the chord given.

It is interesting to notice how the bolded "***then***" in Table 6 emphasizes particular cases related to the application of this property, according to what is defined in [18] and here reinforced. According to this property, it is of interest how "***then***" highlights the particular usage ("indirect usage") of the scales included by the *Messiaen mode #3 (Rotation 1)* over chords not properly generated by these scales as well as the usage ("indirect usage") of the *B minor pentatonic* scale over the *Bm7/5b* and *Dm* chords since both directly generated by the *B 6 notes blues* scale that includes the *B minor pentatonic* scale. The usage of "***then all***" is symptomatic of how the *12 notes chromatic scale* can generate any chord and scale type, i.e. all the potential melody patterns that can be sustained by all the chord types which are all generated and included in the *12 notes chromatic scale.* It has to be specified that the meaning related to the term "indirect usage" expressed in this study is different and more general than the one usually found in literature. Conventionally, the "indirect usage" term refers to the use of *modes* of the same generating scale (rotations of the same scale) over chords (or melody patterns, as will be explained by the following Table 7) not properly related to these *modes* since generated by other degrees of the same main scale (for instance the use of the *D Melodic minor*, *C Melodic minor*, *C Ionian* scales over the *G7* chord generated by its fourth and fifth degrees respectively, or the use of the *Eb Ionian, C Harmonic minor* scales over the *Abmaj7* chord generated by its fourth and sixth degrees respectively, as already reported in Table 6). As it is evident, the term "indirect usage" expressed in this study (and highlighted by "***then***" and "***then all***" in Tables 6 and 7) denotes a more general meaning that includes the conventional one, representing its extremization.

As seen, besides the mutual inclusions among generic groups of notes (scales and chords) the method allows finding out all the different scales (among those considered by the system since chosen by the user-musician) that can be potentially employed over the same chord type and, more in general, on the same chord progression (see the examples reported in Section 5 of the present paper).

The method allows also detecting all the scales (among those considered by the system and chosen by the user-musician) that can generate a given melody pattern potentially sustained by different chords generated by the same scales (that can be characterized by mutual inclusions) as shown by the examples reported in Table 7.

Table.7: Examples of chords generated by different potential scales at the same time that can sustain the same melody pattern.

Melody pattern	***Scales that include the given melody pattern***	***Chords that potentially can sustain the given melody pattern***
C, Eb, D	*C 12 notes chromatic* ***then all****; Eb Ionian, Bb Ionian, C Melodic minor, Eb Melodic minor, A 6 notes blues* ***then*** *C minor pentatonic, D minor pentatonic, F minor pentatonic, G minor pentatonic, A minor pentatonic; C Harmonic minor; G Harmonic minor; C Whole step/half-step diminished; D Messiaen mode #3 (Rotation 1)* ***then*** *C Whole-tone, D Augmented half-step minor-third, C Augmented minor-third half-step*	*All the chords included/generated by the scales that include the given melody pattern*

C, E, D	*C 12 notes chromatic **then all**; C Ionian, F Ionian, G Ionian, F Melodic minor, G Melodic minor, A Melodic minor, A 6 notes blues **then** B minor pentatonic, D minor pentatonic, E minor pentatonic, G minor pentatonic, A minor pentatonic; A Harmonic minor; C Whole-tone; C Messiaen mode #3 (Rotation 1) **then** C Augmented half-step minor-third, D Augmented minor-third half-step; D Messiaen mode #3 (Rotation 1) **then** D Augmented half-step minor-third, C Augmented minor-third half-step*	*All the chords included/generated by the scales that include the given melody pattern*

From Table 7 inspection, it is straightforward to notice and underline the following general property, specularly to what asserted so far:

- A chord (or a group of chords) can sustain a given melody pattern if the chord includes the given melody pattern or if the chord is included in a scale that directly generates the given melody pattern, as well as, a chord (or a group of chords) can sustain a given melody pattern if the chord is included by a bigger chord (one or more) or a bigger scale (one or more) that generates the given melody pattern (besides including also other chords and scales that not necessarily generate the given melody pattern). In this last case the chord (one or more), being included by a bigger chord or a bigger scale (one or more), not necessarily has a direct link with the given melody pattern (the given melody pattern might be generated by the bigger containing chord or scale and not by the included one). Therefore, in this last case, the included chord (one or more), not directly generating the given melody pattern, has a weaker harmonic and melodic connection with the given melody pattern than in the case in which a chord (one or more) or a scale (one or more), even if included by a bigger chord (one or more) or a bigger scale (one or more), directly generates sustaining chords more harmonically and melodically connected to the given melody pattern.

It is interesting to notice that the bolded "***then***" in Table 7 emphasizes particular cases related to the application of this property. According to this property, it is of interest how "***then***" highlights the particular usage ("indirect usage") of scales generating chords that can sustain the melody pattern even if the melody pattern is not properly generated by these scales and chords. This is because these scales and chords are included in the bigger containing scales and chords that generate the given melody pattern (besides including also other chords and scales that do not necessarily generate the given melody pattern). Once again, the usage of "***then all***" demonstrates how the *12 notes chromatic scale* can generate any chord type as well as all the potential melody patterns that can be sustained by all the chord types which are all generated and included in the *12 notes chromatic scale.* The two last properties reported in the present Section can be unified in a general form by considering, as it is, a target chord like a given melody pattern as well as the scales that can be employed over the target chord like the chords that potentially can sustain the given melody pattern.

For the sake of completeness, the chord harmonization (starting from each "degree" of the chord) related to the main chords constituted by three and four notes is reported in Table 8. The fundamental (the first degree of each chord) that has been chosen to present each chord is the *C* note, as a common reference.

Table.8: Chords harmonizations related to the main chords of three and four notes defined in [18].

C7:*C E G Bb*
Cmaj C7 Edim
Cm*:C Eb G*
Cm
C5b*:C E Gb*
C5b
Cmaj*:C E G*
Cmaj
C5#*: C E G#*
C5# E5# G#5#
Cadd9b*:C Db E G*
Cmaj Cadd9b Dbdim Dbm/maj7/5b
Cadd9*:C Db E G*
Cmaj Cadd9
Cmadd4b*:C Eb E G*
Cm Cmaj Cmadd4b Em/maj7/5#
Cm7*:C Eb G Bb*

Cm Cm7 Ebmaj Eb6
***Cadd4**:C E F G*
Cmaj Cadd4
***Cadd4#**:C E F# G*
C5b Cmaj Cadd4#
***C7/5b**:C E Gb Bb*
C5b C7/5b Gb5b Gb7/5b
***C6**:C E G A*
Cmaj C6 Am Am7
***Cmaj7**:C E G B*
Cmaj Cmaj7 Em
***C7/5#**: C E G# Bb*
C5# C7/5# E5b E5# G#5#
***Cdim**:C Eb Gb*
Cdim
***Cm/add9b**:C Db Eb G*
Cm Cmaddb9
***C5b/add9b**:C Db E Gb*
C5b C5badd9b
***Cm/add9**:C D Eb G*
Cm Cmadd9
***Cdim/add4**:C Eb F Gb*
Cdim Cdimadd4
***Cm/add4**:C Eb F G*
Cm Cmadd4
***Cm/add4#**:C Eb F# G*
Cdim Cm Cmadd4#
***Cdim7**:C Eb Gb A*
Cdim Cdim7 Ebdim Ebdim7 Gbdim Gbdim7 Adim Adim7
***Cm7/5b**:C Eb Gb Bb*
Cdim Cm7/5b Ebm Ebm6 Gb5b
***Cm/maj7/5b**:C Eb Gb B*
Cdim Cm/maj7/5b Bmaj Badd9b
***Cm6**:C Eb G A*
Cm Cm6 Eb5b Adim Am7/5b
***Cm/maj7**:C Eb G B*
Cm Cm/maj7 Eb5# G5# B5#
***Cm/maj7/5#**: C Eb G# B*
Cm/maj7/5# G#m G#maj G#madd4b
***C5b/add4**:C E F Gb*
C5b C5badd4
***Cmaj7/5b**:C E Gb B*
C5b Cmaj7/5b
***Cmaj7/5#**: C E G# B*
C5# Cmaj7/5# Emaj E5# G#5#

III. THE REAL HARMONIC CONNECTION DEGREE NUMBER

In the present Section, the *harmonic connection degree number* and the *real harmonic connection degree number* between generic groups of notes introduced in [18] are presented in detail. It has to remember that the *harmonic connection degree number* between generic groups of notes expresses the number of common chords (also known as pivot chords) between scales and/or chords (generic groups of notes). The *real harmonic connection degree number* can be obtained by taking into account all the existent *basic chords* constituted at least by two and a maximum of three notes. The *basic chords* are not explicitly presented but only used and reported in the text as background information (for the sake of brevity). Each *basic chord* contains the minimum group of notes needed to derive all the other chords and in general groups of notes by combining (superposing) different *basic chords* (all the generic groups of notes constituted by four or more notes can be considered as the superposition of two or more *basic chords*). The *real harmonic connection degree number* expresses the number of common *basic chords* between scales and/or chords (generic groups of notes), thus univocally representing the real harmonic connection's level between different generic groups of notes.

The *harmonic connection degree numbers* related to the *C major (ionian)* scale are reported in Table 9 by considering the main chords constituted by three and four notes as pivot chords among the scales types presented in the previous Section. It has to be stressed that the general algorithm implemented in the software tool can manage whatever type of scale having any tonic. For the sake of brevity, only the *harmonic connection degree numbers* related to the *C major (ionian)* scale are reported in Table 9.

Table.9: Harmonic connection degree numbers related to the C major (ionian) scale.

Harmonically compared scales (generic groups of notes)	***Harmonic connection degree number***	***Common chords between the compared scales (pivot chords)***
C Ionian - C 12 notes chromatic	33	*Am Am7 Am/add4 Am/add9 Bdim Bdim/add4 Bm7/5b C6 Cadd4 Cadd9 Cmaj Cmaj7 Dm Dm6 Dm7 Dm/add4 Dm/add9 Em Em7 Em/add4 Em/add9b F5b F6 Fadd4# Fadd9 Fmaj Fmaj7 Fmaj7/5b G6 G7 Gadd4 Gadd9 Gmaj*
C Ionian - D Melodic minor	17	*Bdim Bdim/add4 Bm7/5b Dm Dm6 Dm/add4 Dm/add9 Em Em7 Em/add4 Em/add9b F5b Fmaj7/5b G6 G7 Gadd9 Gmaj*
C Ionian - Eb Messiaen mode #3 (Rotation 1)	16	*Am Am7 Am/add9 C6 Cadd4 Cmaj Cmaj7 Em Em/add4 Em/add9b F5b Fadd4# Fadd9 Fmaj Fmaj7 Fmaj7/5b*
C Ionian - A Harmonic minor	16	*Am Am/add4 Am/add9 Bdim Bdim/add4 Bm7/5b Dm Dm6 Dm7 Dm/add9 F5b F6 Fadd4# Fmaj Fmaj7 Fmaj7/5b*
C Ionian - G Ionian	15	*Am Am7 Am/add4 Am/add9 C6 Cadd9 Cmaj Cmaj7 Em Em7 Em/add4 G6 Gadd4 Gadd9 Gmaj*
C Ionian - F Ionian	15	*Am Am7 Am/add4 C6 Cadd4 Cadd9 Cmaj Dm Dm7 Dm/add4 Dm/add9 F6 Fadd9 Fmaj Fmaj7*
C Ionian - C Melodic minor	15	*Bdim Bm7/5b Dm Dm6 Dm7 Dm/add4 F5b F6 Fadd4# Fadd9 Fmaj G7 Gadd4 Gadd9 Gmaj*
C Ionian - C Whole step/half-step diminished	9	*Bdim Bm7/5b Dm Dm6 Dm7 F5b F6 Fadd4# Fmaj*
C Ionian - C# Messiaen mode #3 (Rotation 1)	9	*Bdim Bm7/5b Dm Dm6 Dm/add4 F5b G7 Gadd9 Gmaj*
C Ionian - E Harmonic minor	8	*Am Am7 Am/add9 C6 Cmaj Cmaj7 Em Em/add4*
C Ionian - D Messiaen mode #3 (Rotation 1)	8	*Cadd9 Cmaj Cmaj7 Em Em7 G6 Gadd4 Gmaj*
C Ionian - D Whole step/half-step diminished	8	*Bdim Bdim/add4 Em Em7 Em/add9b G6 G7 Gmaj*
C Ionian - C Messiaen mode #3 (Rotation 1)	8	*Am Am/add4 Dm Dm7 Dm/add9 F6 Fmaj Fmaj7*
C Ionian - B 6 notes blues	8	*Bdim Bdim/add4 Bm7/5b Dm Dm6 Dm/add9 F5b Fmaj7/5b*
C Ionian - G Melodic minor	6	*Am Am7 Am/add4 C6 Cadd9 Cmaj*
C Ionian - E 6 notes blues	6	*Em Em7 Em/add4 G6 Gadd9 Gmaj*
C Ionian - D Ionian	6	*Em Em7 Em/add4 G6 Gadd9 Gmaj*
C Ionian - D 6 notes blues	6	*Dm Dm7 Dm/add4 F6 Fadd9 Fmaj*
C Ionian - A 6 notes blues	6	*Am Am7 Am/add4 C6 Cadd9 Cmaj*
C Ionian - Bb Ionian	6	*Dm Dm7 Dm/add4 F6 Fadd9 Fmaj*
C Ionian - F# Harmonic minor	5	*Bdim Bm7/5b Dm Dm6 F5b*
C Ionian - C Harmonic minor	4	*Bdim G7 Gadd4 Gmaj*
C Ionian - C Half-step/whole step diminished	4	*Am Am7 C6 Cmaj*
C Ionian - B Harmonic minor	4	*Em Em7 G6 Gmaj*

C Ionian - F Melodic minor	3	*Cadd4 Cadd9 Cmaj*
C Ionian - D Harmonic minor	3	*Dm Dm/add4 Dm/add9*
C Ionian - C Augmented minor-third half-step	3	*Cmaj Cmaj7 Em*
C Ionian - C Augmented half-step minor-third	3	*Am Fmaj Fmaj7*
C Ionian - A Melodic minor	3	*Am Am/add4 Am/add9*
C Ionian - F Harmonic minor	2	*Cadd4 Cmaj*
C Ionian - F# 6 notes blues	2	*Am Am/add9*
C Ionian - E Melodic minor	2	*Em Em/add4*
C Ionian - Bb Melodic minor	2	*Fadd9 Fmaj*
C Ionian - Ab Harmonic minor	1	*Em*
C Ionian - F# Melodic minor	1	*F5b*
C Ionian - D Augmented minor-third half-step	1	*Dm*
C Ionian - D Augmented half-step minor-third	1	*Gmaj*
C Ionian - Eb Harmonic minor	1	*Bdim*
C Ionian - C# Harmonic minor	1	*Am*
C Ionian - C# Whole-tone	1	*F5b*
C Ionian - C# 6 notes blues	1	*Em*
C Ionian - Bb Harmonic minor	1	*Fmaj*

It has to be noted that the *harmonic connection degree number* expresses the harmonic similarity level among generic groups of notes. The harmonically compared scales are classified from the highest to the lowest *harmonic connection degree number*. The *C Ionian* scale (as well as any other considered scale, except for the *12 notes chromatic* scale that is harmonically linked with all the groups of notes) has a harmonic link with some (not all) of the other scales when the above main chords of three and four notes are considered. It has to be noted that among the scale types considered in the present Section and chord types constituted by three and four notes, the *5b/add4* chord type is specific and proper of the *Messiaen mode #3 (Rotation 1)* scale besides of course the *12 notes chromatic scale*. The only harmonic connection allowed by the *5b/add4* chord type is between the *Messiaen mode #3 (Rotation 1)* and the *12 notes chromatic scale* since these are the only scales that directly generate the *5b/add4* chord type. Among all the main chords constituted by three and four notes, the *harmonic connection degree numbers* related to the *C major* chord have been reported in Table 10 as an example, even if the general algorithm implemented in the software tool can handle whatever chord type having any fundamental.

Table.10: Harmonic connection degree numbers related to the C major chord.

Harmonically compared chords (generic groups of notes)	***Harmonic connection degree number***	***Common chords (pivot chords) between the compared chords***
Cmaj - Abmaj7/5#	1	*Cmaj*
Cmaj - Em/maj7/5#	1	*Cmaj*
Cmaj - Cmaj7	1	*Cmaj*
Cmaj - Cmadd4b	1	*Cmaj*
Cmaj - Cadd9b	1	*Cmaj*
Cmaj - Cadd9	1	*Cmaj*
Cmaj - Cadd4#	1	*Cmaj*
Cmaj - Cadd4	1	*Cmaj*

Cmaj - C7	1	*Cmaj*
Cmaj – C6	1	*Cmaj*
Cmaj - C#m/maj7/5b	1	*Cmaj*
Cmaj - Am7	1	*Cmaj*

Similar to what was noticed in Section 2.1, the investigation reported in Table 9 involves the harmonic connections between scales, as well as the one in Table 10 involves the harmonic connections between chords, despite chords and scales can be considered as generic groups of notes, thus legitimately directly compared. From Table 10 inspection it is evident how the *Cmaj* chord is the pivot chord that determines a harmonic link among the *Cmaj* chord family and 12 of the 31 different chord families constituted by three and four notes presented in [18] and primarily considered in the present study. The *real harmonic connection degree numbers* are reported in Table 11 (for the sake of brevity only those related to the *C major/ionian* scale).

Table.11: Real harmonic connection degree numbers related to the C major (ionian) scale.

Harmonically compared scales	***Real harmonic connection degree number***
C Ionian - C 12 notes chromatic	147
C Ionian - G Ionian	90
C Ionian - F Ionian	90
C Ionian - D Melodic minor	90
C Ionian - Eb Messiaen mode #3 (Rotation 1)	90
C Ionian - C Melodic minor	90
C Ionian - A Harmonic minor	90
C Ionian - G Melodic minor	50
C Ionian - F Melodic minor	50
C Ionian - E Harmonic minor	50
C Ionian - E 6 notes blues	50
C Ionian - D Messiaen mode #3 (Rotation 1)	50
C Ionian - D Harmonic minor	50
C Ionian - D Ionian	50
C Ionian - D Whole step/half-step diminished	50
C Ionian - D 6 notes blues	50
C Ionian - C Messiaen mode #3 (Rotation 1)	50
C Ionian - C Harmonic minor	50
C Ionian - C Whole step/half-step diminished	50
C Ionian - C# Messiaen mode #3 (Rotation 1)	50
C Ionian - B 6 notes blues	50
C Ionian - A Melodic minor	50
C Ionian - A 6 notes blues	50
C Ionian - Bb Ionian	50
C Ionian - G Harmonic minor	24
C Ionian - G 6 notes blues	24
C Ionian - F Harmonic minor	24
C Ionian - F# Harmonic minor	24
C Ionian - F# 6 notes blues	24
C Ionian - E Melodic minor	24
C Ionian – Eb Ionian	24
C Ionian - C Half-step/whole step diminished	24
C Ionian - C Augmented minor-third half-step	24
C Ionian - C Augmented half-step minor-third	24
C Ionian - C# Whole-tone	24
C Ionian - B Harmonic minor	24
C Ionian - A Ionian	24
C Ionian - Bb Melodic minor	24

C Ionian - Ab Melodic minor	9
C Ionian - Ab Harmonic minor	9
C Ionian - Ab Ionian	9
C Ionian - F 6 notes blues	9
C Ionian - F# Melodic minor	9
C Ionian - E Ionian	9
C Ionian - D Augmented minor-third half-step	9
C Ionian - D Augmented half-step minor-third	9
C Ionian - Eb Melodic minor	9
C Ionian - Eb Harmonic minor	9
C Ionian - C Whole-tone	9
C Ionian - C 6 notes blues	9
C Ionian - C# Harmonic minor	9
C Ionian - C# 6 notes blues	9
C Ionian - B Melodic minor	9
C Ionian - Bb Harmonic minor	9
C Ionian - Ab 6 notes blues	2
C Ionian – F# Ionian	2
C Ionian - C# Melodic minor	2
C Ionian - C# Ionian	2
C Ionian - B Ionian	2
C Ionian - Bb 6 notes blues	2

Comparing Tables 11 and 9 it is possible to notice that the *real harmonic connection degree number* and the *harmonic connection degree number* do not coincide. These can coincide if the *basic chords* are exclusively taken into account in the harmonic comparison investigation. Only the *real harmonic connection degree number* is needed to quantitatively and synthetically represent the real harmonic connection's level between different scales. As already introduced in [18], the classification related to the compared scales from the highest to the lowest *real harmonic connection degree number* reported in Table 11 would coincide with the one denoted by the *harmonic connection degree number* reported in Table 9 only if all the *basic chords* were taken into account and included in both the harmonic comparison investigation analyses. Since all the existent *basic chords* have been considered in the analysis reported in Table 11, the *C Ionian* scale presents a harmonic link with all the other scales considered in this Section except with the *Eb 6 notes blues* scale that (among the scales considered in this Section) is the harmonically (and firstly melodically) farthest scale from the *C Ionian* scale since these scales have only one common note (the *A* note from the comparison at the same *k* number of notes). Furthermore, all the *basic chords* are favorably employed allowing a harmonic connection among the scales considered in this Section. Then, there is no *basic chord* univocally proper of a specific scale besides of course the *12 notes chromatic scale*. The *real harmonic connection degree numbers* among the scales primarily considered in the present study demonstrate that the *12 notes chromatic*, *Harmonic minor*, *Melodic minor*, *Messiaen mode #3 (Rotation 1)*, *Whole step/half-step diminished*, *Half-step/whole step diminished* scale families have a harmonic link with all the other scales through the *basic chords.* The same does not happen for the *Ionian, 6 notes blues, Whole-tone, Augmented minor-third half-step, Augmented half-step minor-third* scale families since each *Ionian* scale is not harmonically linked with the *6 blues scale* built on a minor third ahead as well as the *C Whole-tone* scale is not harmonically linked with the *C# Whole-tone* scale as well as the *C Augmented minor-third half-step* scale is not harmonically linked with the *D Augmented minor-third half-step* scale as well as the *C Augmented half-step minor-third* scale is not harmonically linked with the *D Augmented half-step minor-third* scale. The scales that originally have a low number of notes tend to have a low *real harmonic connection degree number* by their nature, despite their high melodic connection level with the bigger scales to which they relate to. These scales that are constituted by a low number of notes are often included and similar to the bigger ones. This concept leads to the *melodic connection degree number*.

IV. THE MELODIC CONNECTION DEGREE NUMBER

In the present Section, the *melodic connection degree number* related to each scale type (among those primarily considered in the present study) is presented in detail. The *melodic connection degree number* has been introduced in

[18] and expresses the number of scales and/or chords (generic groups of notes) that are similar to each scale or chord (generic group of notes). It has to be stressed that chords (being little scales that can contain other chords as well as being generated by bigger scales) can be harmonically and melodically compared and also directly compared with scales. In general, the present method allows to melodically compare all the chords and scales, thus detecting the *melodic connection degree number* related to each chord or scale. The *melodic connection degree number* represents the melodic level of connection among scales and/or chords in absolute terms. A scale or chord characterized by a high *melodic connection degree number* has a high corresponding number of connected scales [18] and/or chords. Being the chords generated/included into the scales, chords are unavoidably similar thus connected to the scales from which are generated. All the scales and chords considered in the present study are included (thus similar and connected) in the *12 notes chromatic scale*. Tables 4 and 5 reported in the present study show the mutual inclusions (thus melodic connections) among the scales and chords primarily considered in the present study. As described in [18], the algorithm of the present method compares the scales at the same *k* number of notes (if two compared scales are originally characterized by a different *k*, the additional uncommon notes between the two scales have not to be taken into consideration in the comparison process). To be declared similar, two scales of *k* notes must have at least (*k-1*) common notes. It has to be specified that even if the *modes* of a scale and chord *inversions* would satisfy the already stated mathematical similarity condition, these are not considered in the melodically-based similarity comparison. This is because the *modes* of a scale and chord *inversions* result as rotations of the same considered scale and chord respectively assuming only a different first-degree note (*modes* of a scale and *inversions* of a chord are constituted by the same notes of the original scale and chord respectively despite having only a different name). Taking the concept to extremes, it is possible to highlight that, according to the present parsimonious model algorithm, every single note is similar thus formally connected to the other ones, as reported in Fig.1.

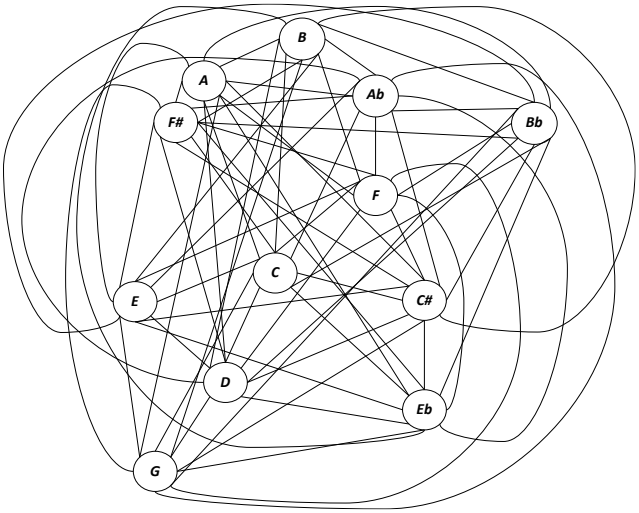

Fig. 1: Melodic connection degree numbers among all the single notes constituting the music network.

It has to be stressed that the general algorithm implemented in the software tool can manage whatever type of scale having any tonic. For the sake of brevity, only the *melodic connection degree numbers* related to each scale type primarily considered in the present study having the *C* note as the first degree have been reported in Table 12.

Table.12: Melodic connection degree numbers related to each scale type having the C note as the first-degree of the scale.

Scale	***Melodic connection degree number***	***Connected/similar scales***
C Ionian	11	*F Ionian* *G Ionian* *C Melodic minor* *D Melodic minor* *A Harmonic minor* *D 6 notes blues* *E 6 notes blues* *A 6 notes blues* *B 6 notes blues* *Eb Messiaen mode #3 (Rotation 1)*

		C 12 notes chromatic
C Melodic minor	10	*C Ionian* *Bb Ionian* *C Harmonic minor* *D 6 notes blues* *A 6 notes blues* *C# Whole-tone* *C Whole step/half-step diminished* *C# Messiaen mode #3 (Rotation 1)* *Eb Messiaen mode #3 (Rotation 1)* *C 12 notes chromatic*
C Harmonic minor	9	*Eb Ionian* *C Melodic minor* *D 6 notes blues* *F 6 notes blues* *C Whole step/half-step diminished* *C Augmented minor-third half-step* *D Messiaen mode #3 (Rotation 1)* *Eb Messiaen mode #3 (Rotation 1)* *C 12 notes chromatic*
C 6 notes blues	12	*C# Ionian* *Eb Ionian* *Ab Ionian* *Bb Ionian* *Eb Melodic minor* *Bb Melodic minor* *G Harmonic minor* *Bb Harmonic minor* *C Half-step/whole step diminished* *C# Messiaen mode #3 (Rotation 1)* *D Messiaen mode #3 (Rotation 1)* *C 12 notes chromatic*
C Whole-tone	9	*C# Melodic minor* *Eb Melodic minor* *F Melodic minor* *G Melodic minor* *A Melodic minor* *B Melodic minor* *C Messiaen mode #3 (Rotation 1)* *D Messiaen mode #3 (Rotation 1)*

		C 12 notes chromatic
C Half-step/whole step diminished	13	*C# Melodic minor* *E Melodic minor* *G Melodic minor* *Bb Melodic minor* *C# Harmonic minor* *E Harmonic minor* *G Harmonic minor* *Bb Harmonic minor* *C 6 notes blues* *Eb 6 notes blues* *F# 6 notes blues* *A 6 notes blues* *C 12 notes chromatic*
C Whole step/half-step diminished	13	*C Melodic minor* *Eb Melodic minor* *F# Melodic minor* *A Melodic minor* *C Harmonic minor* *Eb Harmonic minor* *F# Harmonic minor* *A Harmonic minor* *D 6 notes blues* *F 6 notes blues* *Ab 6 notes blues* *B 6 notes blues* *C 12 notes chromatic*
C Augmented half-step minor-third	6	*C# Harmonic minor* *F Harmonic minor* *A Harmonic minor* *C Messiaen mode #3 (Rotation 1)* *Eb Messiaen mode #3 (Rotation 1)* *C 12 notes chromatic*
C Augmented minor-third half-step	6	*C Harmonic minor* *E Harmonic minor* *Ab Harmonic minor* *D Messiaen mode #3 (Rotation 1)* *Eb Messiaen mode #3 (Rotation 1)* *C 12 notes chromatic*
C Messiaen	25	*C# Ionian*

mode #3 (Rotation 1)		*F Ionian* *A Ionian* *C# Melodic minor* *Eb Melodic minor* *F Melodic minor* *G Melodic minor* *A Melodic minor* *B Melodic minor* *C# Harmonic minor* *D Harmonic minor* *F Harmonic minor* *F# Harmonic minor* *A Harmonic minor* *Bb Harmonic minor* *D 6 notes blues* *Eb 6 notes blues* *F# 6 notes blues* *G 6 notes blues* *Bb 6 notes blues* *B 6 notes blues* *C Whole-tone* *C Augmented half-step minor-third* *D Augmented minor-third half-step* *C 12 notes chromatic*
C 12 notes chromatic	61	*C Ionian* *C# Ionian* *D Ionian* *Eb Ionian* *E Ionian* *F Ionian* *F# Ionian* *G Ionian* *Ab Ionian* *A Ionian* *Bb Ionian* *B Ionian* *C Melodic minor* *C# Melodic minor* *D Melodic minor* *Eb Melodic minor*

		E Melodic minor *F Melodic minor* *F# Melodic minor* *G Melodic minor* *Ab Melodic minor* *A Melodic minor* *Bb Melodic minor* *B Melodic minor* *C Harmonic minor* *C# Harmonic minor* *D Harmonic minor* *Eb Harmonic minor* *E Harmonic minor* *F Harmonic minor* *F# Harmonic minor* *G Harmonic minor* *Ab Harmonic minor* *A Harmonic minor* *Bb Harmonic minor* *B Harmonic minor* *C 6 notes blues* *C# 6 notes blues* *D 6 notes blues* *Eb 6 notes blues* *E 6 notes blues* *F 6 notes blues* *F# 6 notes blues* *G 6 notes blues* *Ab 6 notes blues* *A 6 notes blues* *Bb 6 notes blues* *B 6 notes blues* *C Whole-tone* *C# Whole-tone* *C Half-step/whole step diminished* *D Whole step/half-step diminished* *C Whole step/half-step diminished* *C Augmented half-step minor-third* *D Augmented minor-third half-step* *D Augmented half-step minor-third*

		C Augmented minor-third half-step *C Messiaen mode #3 (Rotation 1)* *C# Messiaen mode #3 (Rotation 1)* *D Messiaen mode #3 (Rotation 1)* *Eb Messiaen mode #3 (Rotation 1)*

Tables 11 and 12 demonstrate how the scales that originally have a lower number of notes tend to have a lower *real harmonic connection degree number* by their nature, despite their high melodic connection level (*melodic connection degree number*) with the bigger scales to which they relate to. Each *melodic connection degree number* involves scales connected at the same melodic level to each scale. Each *melodic connection degree number* does not necessarily imply the same harmonic level of connection that instead is represented by the *real harmonic connection degree number* among the same scales. This aspect can be seen by observing and comparing the numbers and the related involved scales reported in Table 11 and Table 12 (for the sake of brevity only those related to the *C major/ionian* scale). Table 12 expresses that the *C major (ionian)* scale is melodically connected to the *D 6 notes blues*, *E 6 notes blues*, *A 6 notes blues*, *B 6 notes blues* scales, as well as the *F Ionian, G Ionian, C Melodic minor, D Melodic minor, A Harmonic minor, Eb Messiaen mode #3 (Rotation 1)* scales despite Table 11 reports that the *C major (ionian)* scale has a lower *real harmonic connection degree number* related to the *6 notes blues* scales (and a higher *real harmonic connection degree number* related to the *Ionian, Melodic minor, Harmonic minor, Messiaen mode #3 (Rotation 1)* scales). Viceversa, the same *real harmonic connection degree number*, involving scales connected at the same harmonic level, necessarily implies the same melodic level of connection that is represented by the *melodic connection degree number* among the same scales. This aspect can be seen by observing and comparing the numbers and the related involved scales reported in Table 11 and Table 12. In most of the cases involving scales having the same number of notes, the scales connected at the same melodic level to each scale (for example those connected to the *C major/ionian* scale) necessarily provide the same corresponding harmonic level of connection represented by the *real harmonic connection degree number* (those related to the *C major/ionian* scale). More in general, scales having the same number of notes and melodically similar are also necessarily harmonically linked at the same level (according to the number of notes and consequently of *basic chords* generated by each considered scale). Among the scales of 7 notes melodically connected to the *C major (ionian)* scale (Table 12), the *F Ionian, G Ionian, C Melodic minor, D Melodic minor, A Harmonic minor* scales provide the same corresponding high value of the *real harmonic connection degree number* (Table 11). Among all the main chords constituted by three and four notes, the *melodic connection degree numbers* related to each chord type of three notes having the *C* note as the fundamental have been reported in Table 13 as an example, even if the general algorithm implemented in the software tool can handle whatever chord type having any fundamental.

Table.13: Melodic connection degree numbers related to each chord type of three notes and having the C note as the fundamental of the chord.

Chord	***Melodic connection degree number***	***Connected/similar chords***
Cmaj	9	***C#dim*** ***Edim*** ***Cm*** ***Em*** ***Am*** ***C5b*** ***C5#*** ***E5#*** ***Ab5#***
Cm	9	***Cdim*** ***Adim*** ***Eb5b*** ***Cmaj*** ***Ebmaj*** ***Abmaj*** ***Eb5#*** ***G5#*** ***B5#***
C5#	9	***C#m*** ***Fm*** ***Am***

		C5b
		E5b
		Ab5b
		Cmaj
		Emaj
		Abmaj
C5b	8	***Cdim***
		F#dim
		Am
		F#5b
		Cmaj
		C5#
		E5#
		Ab5#
Cdim	9	***Ebdim***
		F#dim
		Adim
		Cm
		Ebm
		C5b
		F#5b
		Abmaj
		Bmaj

It is interesting to notice that some melodic similarity connections among the chords of the major (*maj*) and minor (*m*) families reported in Table 13 represent also some examples of *diatonic substitution* type. This kind of harmonic substitution involves the similar chords included/generated by the same scale and conventionally takes place when the tonal scales of seven notes (*major/ionian, melodic minor, harmonic minor, harmonic major, double harmonic* and other scales) and all the existent bigger scales which contain them are considered. On the other hand, it has to be noted that Table 13 includes all the chords similar to each chord type of three notes having the *C* note as the fundamental in more general terms (in some cases unrelated to a specific scale, accordingly to the *melodic connection degree number* general definition). Similarly to what was noticed in Section 2.1 and Section 3 of the present paper, the investigation reported in Table 12 involves the melodic connections among scales, as well as the one in Table 13 involves the melodic connections among chords, despite chords and scales can be considered as generic groups of notes, thus legitimately directly compared. It has to remember that the computed *melodic connection degree number* related to each scale allows to express and build the network of the music connections among chords and scales introduced and described in detail in [18]. This network is constituted by superposed geometric graphs of connections (that can also represent mutual inclusions) among the generic groups of notes.

V. THE FLOW OF SOUND PATHWAYS GENERATED BY THE GROUPS OF NOTES ARBITRARILY EMITTED

In the present Section, harmonic analysis examples of some chord progressions reported in [18] have been provided (namely Case#2, Case#3). In the present study, these analyses include also some scales (not all) related to the *Modes of limited transposition* [6]. The analyses have been carried out in terms of the graphic and time-dependent network constituted by the considered chords and scales which are melodically connected. In particular, the *Harmonic minor, Melodic minor, Ionian, Half-step/whole step diminished, Whole step/half-step diminished, Messiaen mode #3 (Rotation 1)* scale families have been considered in the analyses. It has to be noted that these scale families are considered also in [7] and that the *Messiaen mode #3 (Rotation 1)* scale family includes the *Whole-tone* (having the same first-degree note), *Augmented half-step minor-third* (having the same first-degree note), *Augmented minor-third half-step* (having the first-degree note one tone ahead) scale families as previously reported in Table 4. The graph that expresses the *melodic connection degree numbers* among scales reported in Fig. 2 has been chosen to represent the music transient process related to the chord progression of each Case. This choice confers a good representation clarity as well as provides a better description and justification in graphical terms of some of the harmonic and melodic passages related to the chord progressions reported in [18] and in the present paper.

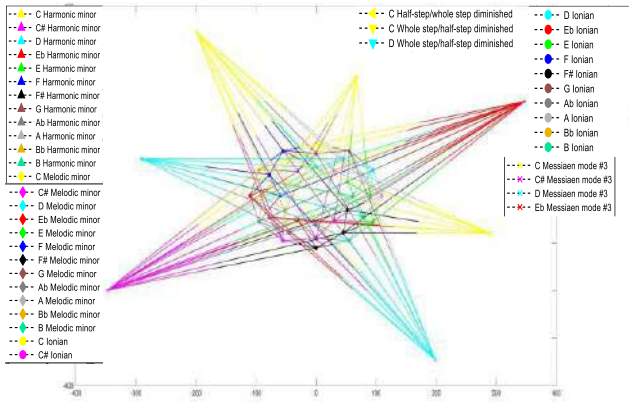

Fig. 2: Harmonic minor, Melodic minor, Major/Ionian, Half-step/whole step diminished, Whole step/half-step diminished and Messiaen mode #3 (Rotation 1) scale families.

Case#2 is characterized by the chord progression reported in Table 14:

Table.14: Chord progression related to Case#2

Cmaj7	*Cmaj7*	*Fm7*	*Bb7*
Cmaj7	*Cmaj7*	*Bbm7*	*Eb7*
Abmaj7	*Abmaj7*	*Am7*	*D7*
Dm7	*G7*	*Cmaj7 Eb7*	*Abmaj7G7/5#*

It is possible to graphically represent the chord progression related to Case#2 by adopting different *N* values. In particular, the value related to *N=2* has been employed for the first six bars (Figs. 3, 4), the value related to *N=4* has been employed from the 7th to 10th bar (Fig. 5), the value related to *N=2* has been employed from the 11th to 12th bar (Fig. 6), the value related to *N=3* has been employed from the 13th to 15th bar (Fig. 7), the value related to *N=2* has been employed from the 15th to 16th bar (Figs. 8 and 9). The whole music-transient process related to the chord progression denoted by Case#2 is summarized by Fig. 10 for the different *N* values.

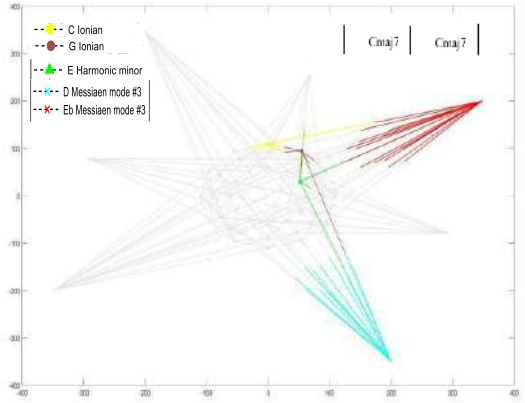

Fig. 3: Case#2 related to N=2: 1st, 2nd, 5th and 6th bars.

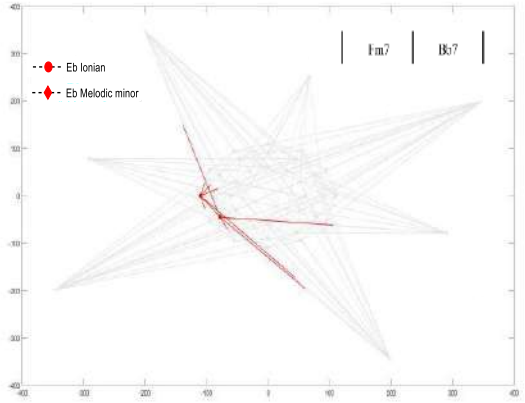

Fig. 4: Case#2 related to N=2: 3rd and 4th bars.

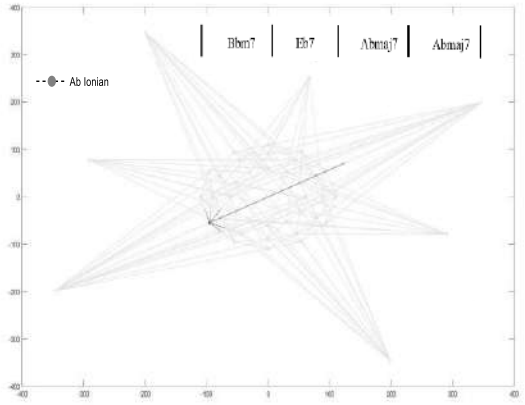

Fig. 5: Case#2 related to N=4: 7th, 8th, 9th and 10th bars.

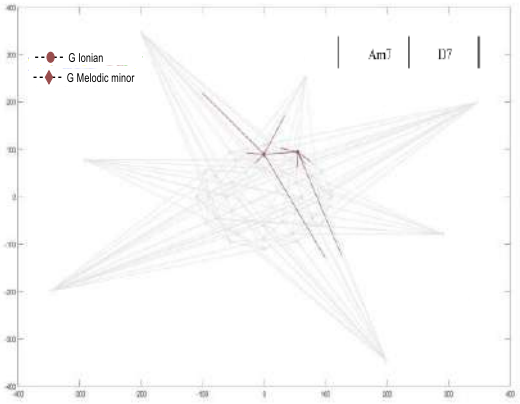

Fig. 6: Case#2 related to N=2: 11th and 12th bars.

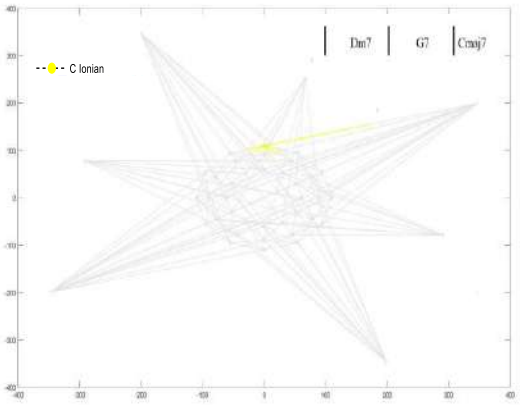

Fig. 7: Case#2 related to N=3: 13th, 14th and 15th bars.

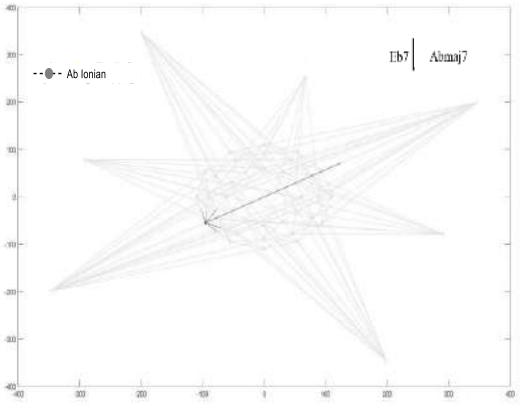

Fig. 8: Case#2 related to N=2: 15th and 16th bars.

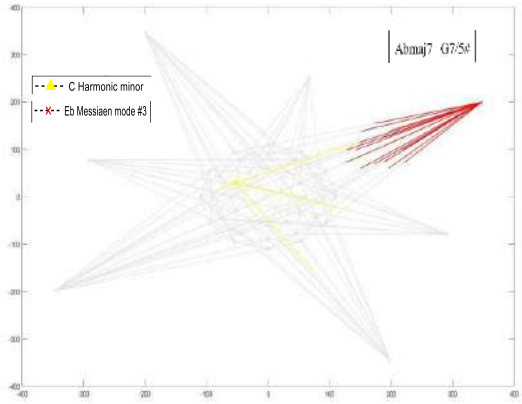

Fig. 9: Case#2 related to N=2: 16th bar.

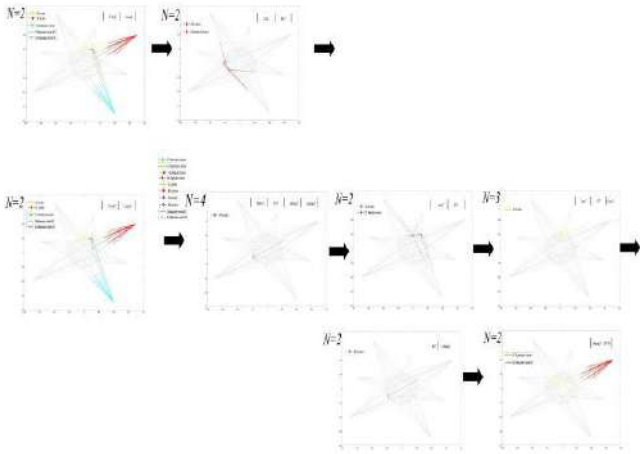

Fig. 10: The flow of sound pathways through the music network related to the chord progression denoted by Case#2 for different N values.

Case#3 is characterized by the chord progression reported in Table 15:

Table.15: Chord progression related to Case#3

Ebmaj7	*Ebmaj7*	*Ebm7*	*Ab7*
Abmaj7	*Abmaj7*	*Abm7*	*Db7*
Ebmaj7	*F#m7 B7*	*Fm7*	*Bb7*
Ebmaj7	*F#m7 B7*	*Fm7*	*Bb7*

It is possible to graphically represent the chord progression related to Case#3 by adopting different *N* values. In particular, the value related to *N=2* has been employed for the first eight bars (Figs. 11 to 14), the value related to *N=1* has been employed for the 9th and 13th bar (Fig. 15), the value related to *N=2* from the 10th to 12th bar and from the 14th to 16th bar (Figs. 16 and 17). The whole music-transient process related to the chord progression

denoted by Case#3 is summarized by Fig. 18 for the different *N* values.

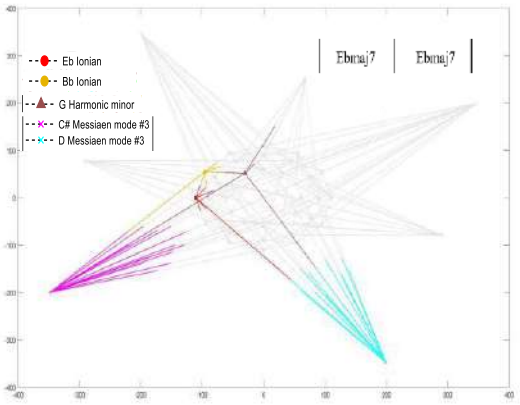

Fig. 11: Case#3 related to N=2: 1st and 2nd bars.

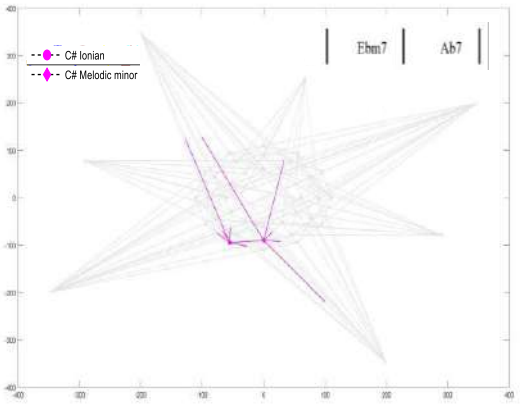

Fig. 12: Case#3 related to N=2: 3rd and 4th bars.

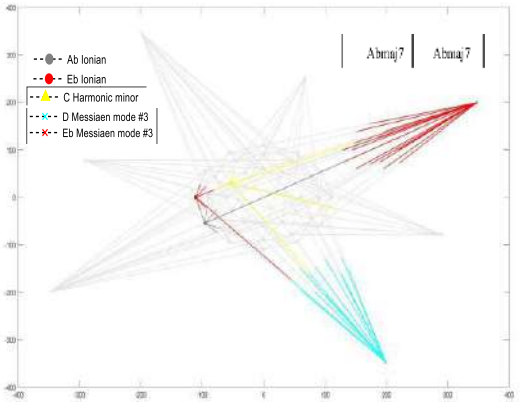

Fig. 13: Case#3 related to N=2: 5th and 6th bars.

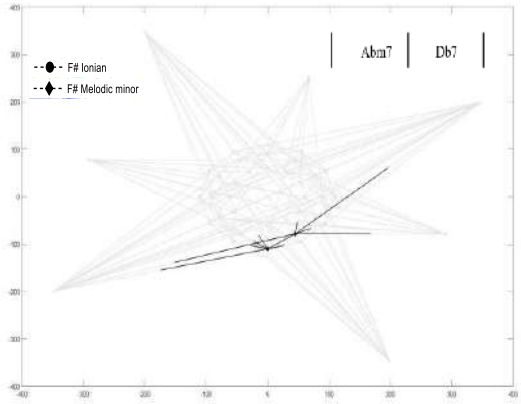

Fig. 14: Case#3 related to N=2: 7th and 8th bars.

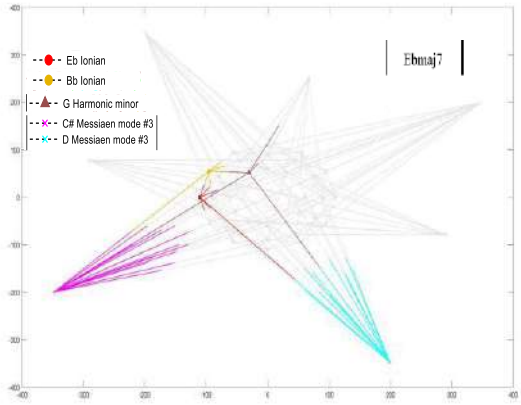

Fig. 15: Case#3 related to N=1: 9th and 13th bars.

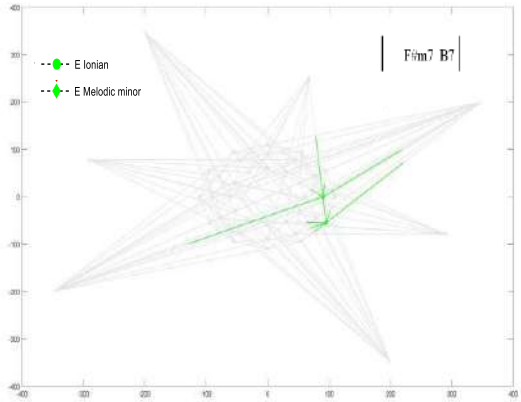

Fig. 16: Case#3 related to N=2: 10th and 14th bars.

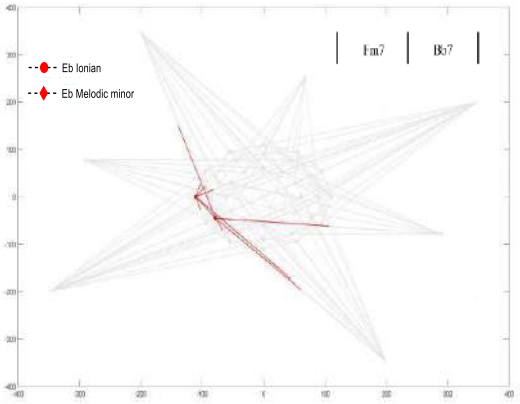

Fig. 17: Case#3 related to N=2: 11th, 12th, 15th and 16th bars.

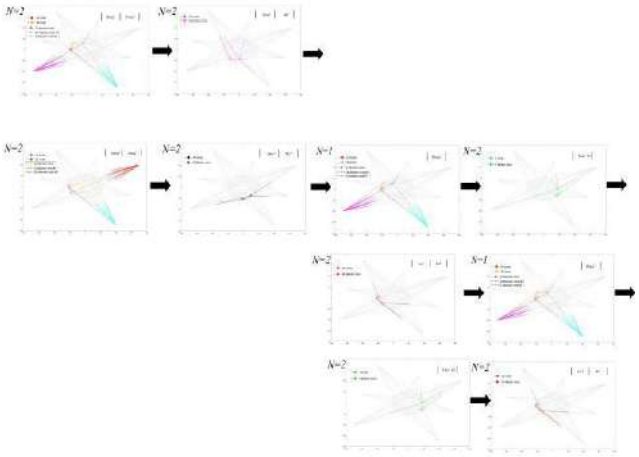

Fig. 18: The flow of sound pathways through the music network related to the chord progression denoted by Case#3 for different N values.

VI. FURTHER APPLICATIONS AND FUTURE PERSPECTIVES RELATED TO THE MUSIC NETWORK GRAPHS

By observing these graphs it is interesting to notice how new perspectives for what concerns music improvisation can be experimented employing the geometrical-based approach that constitutes the music network graphs. In particular, it can be demonstrated how following the trajectories traced by the parsimonious voice-leading approach to connect generic groups of notes (scales and chords) can provide a human ear-friendly response. These trajectories are the graphical expression of the *melodic connection degree number*. The next example is aimed to demonstrate that, among all potential applications related to the present method, it is possible to generate a melody pattern (or a chord progression pattern) following a specific elemental geometric feature/pattern of connected generic groups of notes, as reported in Fig. 19. This elemental geometric pattern is constituted by five nodes (five groups of notes that are scale families in this case). The elemental geometric pattern considered in the graph can be followed iteratively touching these scale families in this specific order exploiting exclusively the common notes between two adjacent nodes (among all the potential orders and scale families that can be considered): *C Harmonic minor, F 6 notes blues, Ab Major (Ionian), Bb Melodic minor, Bb Harmonic minor, F Harmonic minor, etc*. Therefore the following elemental melody pattern can be generated (among all the potential generable melody patterns): *F Ab B C F C Ab F (*common notes between *C Harmonic minor* and *F 6 notes blues* scales*) Ab C Eb F Ab Eb Bb Ab (*common notes between *F 6 notes blues, Ab Major (Ionian)* scales*) Bb Db F G Bb G F Db (*common notes between *Ab Major (Ionian)* and *Bb Melodic minor* scales*) Bb Db F A C A F A (*common notes between *Bb Melodic minor* and *Bb Harmonic minor* scales*)*. Then it is possible to iteratively follow the same pattern among nodes of connected scale families starting from the *F Harmonic minor* scale (notice the switch between the *Bb Harmonic minor* and *F Harmonic minor* scales instead of exploiting the common notes between these nodes) and consequently graphically (thus also musically) transpose the same geometric pattern until the same original feature is obtained again on the graph (closing the circle of multiple "tones" each representing a specific group of notes, in this case a specific scale family) as expressed by Figs. 20 and 21. It has to be noted that the reported elemental melody pattern can be considered generated at the same time also by other scale families (other potential elemental geometric patterns in the music network are generators of the same melody pattern).

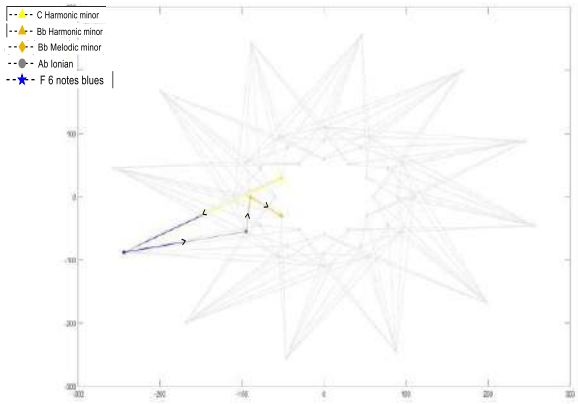

Fig. 19: Generation of a melody pattern following a specific elemental geometric feature/pattern of connected generic groups of notes.

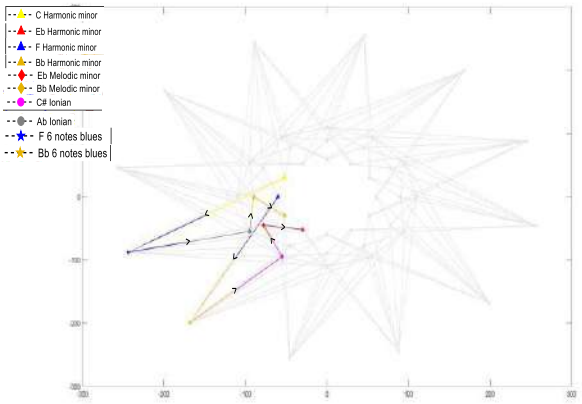

Fig. 20: Iterative transposition of the same elemental geometric melody pattern switching between the Bb Harmonic minor and F Harmonic minor scales.

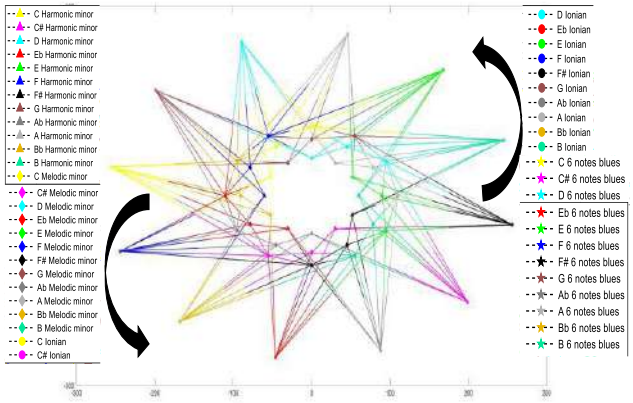

Fig. 21: Iterative transposition of the same elemental geometric melody pattern closing the circle of multiple "tones" each representing a specific group of notes.

A final consideration on chords (and also scales) that have different names even if constituted by the same notes (chord *inversions* and *modes* of a scale). These chord *inversions* or *modes* of a scale can be suitably employed for defining new perspectives in the music network graphs application, specifically for what concerns the inversion substitutions in case of chords and rotations of the main scale in case of scales. In particular, it has to be noted how each node in the music network graphs represents a specific group of notes (scale or chord). Focusing on the tonal scales of seven notes (*major/ionian, melodic minor, harmonic minor, harmonic major, double harmonic* and other scales) and the related *modes*, it is possible to physically place a sort of "handpan resonator" [19, 20] on the conceptual center corresponding to the coordinate of each node of a music network graph. In this manner, a sort of big "handpan" instrument (constituted by the whole group of "handpan resonators" put on each node of the music network) incorporating all the 12 scales of each tonal scale family of seven notes and the related seven *modes* can turn out. Thus, more specifically, seven "handpan resonators" (one for each *mode*) are arranged in a circle around each node of a music network graph conceptually representing in a synthesized/condensed manner each tonal scale of seven notes and related surrounding *modes*. An example of the criteria with which these "handpan resonators" can be mutually arranged is expressed in Fig. 22 considering the nodes' centers coordinates related to the conventional tonal scale families of seven notes (*major/ionian, melodic minor, harmonic minor*).

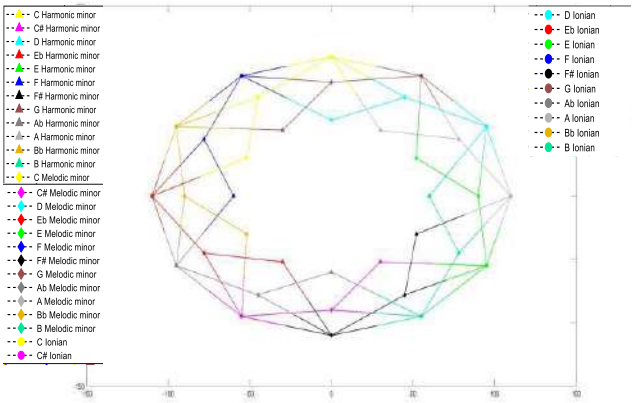

Fig. 22: Harmonic minor, Melodic minor and Major/Ionian scale families as the nodes' centers coordinates corresponding to each "tonal" handpan resonator and the related surrounding "modal" handpan resonators.

From Fig. 22 inspection it is clear how each conceptual music network graph can easily become a physical "handpan resonators" network. The network of "handpan resonators" can be played, for instance, by several people located at the same time on different points/coordinates of the network. Sometimes, also for demonstration purposes, they can resonate the same melody patterns/generic groups of notes arbitrarily emitted from different places in the network, each representing a different scale family whose embedded modes generate one or more specific chords that at the same time are shared by resonating handpans located in the network at different locations. It is evident that the present method introduced in [18] and further developed in the present study considers the circle of fifths only as one of the possible musical dimensions. These dimensions intersect each other and overlap while maintaining alive the mutual nodal interconnections by establishing a network in which mechanisms of self-similarity and symmetries are self-generated recurring periodically. This would demonstrate how in the future, it may no longer be necessary to learn any specific fingering on musical

instruments. The dexterity and the technical research will remain necessary, but the filtering activity will be managed automatically and externally through appropriate switches that electronically and automatically will prevent some notes to be played according to the current tastes preprocessed by the system and possibly modified by the musician user in real-time directly on the instrument equipped with appropriate selectors. Therefore the musician user will not have to worry about what to play and what not to play, thus he will be allowed to focus entirely on the development of technique and rhythmic figurations within the range of notes that he is allowed to play in a dynamic time-varying regime. Therefore he will begin to get used to a new perspective that conceptually facilitates the musician playing of each instrument. The musician of each kind of instrument will be allowed to feel like playing the white keys of the piano all the time thanks to the electronic help that tracks the music in real-time. This logic can also be applied, for example, to an electronic mixer in which the signals of what is played by the band are crossed in real-time. The musician users play harmonic and percussive instruments to which each user can autonomously apply filters. In addition, each instrument emits sounds according to what is played by the others (each electronic filter acting on each instrument "knows" in real time the basic parameters that characterize the filters acting on other instruments that are playing, as they are all connected to a common mixer that may apply, as a Master, its own specific filter or the superposition of the actions operated by electronic filters acting separately on each instrument and constituting the music electronic network on which the band is based).

VII. CONCLUSIONS

The music universe can be considered as constituted by groups and subgroups of vibrations arbitrarily emitted and generated by strings. These vibrations are related to groups and subgroups of frequencies that allow determining the chromo-harmonic structures whose shape is arbitrarily chosen. According to the present model, these groups and subgroups of frequencies can be represented in a condensed form through the use of arbitrary symbols that are mutually interconnected (and also mutually included very often) according to the *melodic connection degree number*.

- Each group and subgroup of frequencies can be considered as a single part of the entire system to be separately (individually) analyzed as if the other groups did not exist. On the other hand, these connected groups and subgroups of frequencies can be considered together as a part of the same investigated bigger system (or of the entire system which is constituted by all the parts parallelly coexisting) even if contained in each other (hence the term subgroups).

- Through an appropriate filtering operation (that is arbitrarily operated by the musician-user subjectivity) and a suitable zooming operation, it is possible to intercept and isolate the specific group of frequencies of interest and observe every single part of the music universe from different perspectives (those arbitrarily observed at that time).

Therefore these perspectives can be different each time (depending on the choice operated by the musician-user at that time). Several possible configurations of groups and subgroups of frequencies to be individually considered and investigated at the same time would turn out if a different filtering operation and the same or a different zoom level were chosen by the musician-user. These configurations can be constituted exclusively by the new groups and subgroups of frequencies that appear as the new filtering and zooming operation is carried out as well as by the same configurations previously investigated as interfaced together with the new ones. These new configurations of groups could even have never been explored by musician-observers and could remain unexplored but their constituting mutual interconnections and logical patterns have already been traced according to the *melodic connection degree number* and therefore have always been parallelly existed in any case. They only had been waiting to be intercepted/tracked by the musician-observer subjectivity. Thus, each group and subgroup of frequencies can be seen and analyzed separately (when considered as a single part of the entire system which is constituted by all the parts parallelly coexisting) or together with the other groups and subgroups as a part of the same investigated bigger system (or of the entire system). It is important to notice that these logical patterns exist regardless of the instrument employed to produce/emit these groups and subgroups of vibrations (and the associated frequencies) since are represented in a symbolical synthetic way through interconnected nodes in a geometrical network. The musician user will be able to start experimenting with improvisational techniques that try to arbitrarily follow the trajectories constituting the structure of the electronic filter on which each instrument will be possibly based. This structure has been determined a priori based on subjective aesthetic choices that lead to a sort of music state diagrams in a dynamic time-varying regime. The present study and the related methodological approach fit into the line of research aimed at making each musician increasingly aware of the many melodic and harmonic possibilities. This can also be useful in order to train/guide an automatic

machine to the composition and study and analysis of improvisation.

NOMENCLATURE

Notes names:

C = (B#)

C# = Db

D

D# = Eb

E = (Fb)

F = (E#)

F# = Gb

G

G# = Ab

A

A# = Bb

B = (Cb)

Interval names:

1/8= perfect unison/perfect octave

(1#)= (augmented unison)

2b/9b= minor second/minor ninth

2/9= major second/major ninth

2#/9# =augmented second/augmented ninth

3b =minor third

3= major third

(3#) =(augmented third)

(4b/11b) =(diminished fourth/diminished eleventh)

4/11= perfect fourth/perfect eleventh

4#/11# = augmented fourth/augmented eleventh

5b=diminished fifth

5=perfect fifth

5#= augmented fifth

6b/13b =minor sixth/minor thirteenth

6/13= major sixth/major thirteenth

(6#/13#)=(augmented sixth/augmented thirteenth)

(7bb)=(diminished seventh)

7b= minor seventh

7 = major seventh

(7#)= (augmented seventh)

(8b) =(diminished octave)

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Interculturality in Education Field

Interculturalidade na Educação do Campo

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Keywords *— Interculturality; Countryside Education; Educational Practices.*

Palavras-chave *— Interculturalidade; Educação do Campo; Práticas Educativas.*

Abstract *— The present study is justified by the importance of reflecting on educational practices and the teaching-learning process of rural schools, which disregard the culture of peasants and are dissociated from their experiences, and which promote the devaluation of the countryside as a producing locus of culture and knowledge. Thus, the main objective of the study is to discuss intercultural educational practices that should be developed in rural schools, through the construction of teaching projects that are based on transformative education, involving the context and as multidimensionalities of the local community to practices educational. Furthermore, the methodology used involves a bibliographical review, developed from the reading, interpretation of books and other publications on the subject.*

Resumo *— O presente estudo se justifica pela importância de reflexão sobre as práticas educativas e o processo de ensino-aprendizagem das escolas do campo, que desconsideram a cultura dos campesinos e estão dissociados de suas vivências, e que promove a desvalorização do campo enquanto locus produtor de cultura e conhecimento. Dessa maneira, o principal objetivo do estudo é discutir práticas educativas interculturais que devem ser desenvolvidas nas escolas do campo, por meio da construção de projetos de ensino que se pautem em uma educação transformadora, que envolva o contexto e as multidimensões da comunidade local às práticas educacionais. Ademais, a metodologia utilizada envolve uma revisão bibliográfica, desenvolvida a partir da leitura, interpretação de livros e demais publicações sobre o tema.*

I. INTRODUÇÃO

O presente estudo se justifica pela importância de refletir sobre as práticas educativas e o processo de ensino-aprendizagem das escolas do campo em razão da problemática do desenvolvimento de uma educação que não subjugue a população da zona rural a um "projeto educacional" que desconsidera a sua cultura e está dissociado de suas vivências, e que promove a desvalorização do campo enquanto *locus* produtor de cultura e conhecimento.

O Decreto nº 7.352, de 4 de novembro de 2010, que dispõe sobre a política de educação do campo e o

Programa Nacional de Educação na Reforma Agrária - PRONERA, define a escola do campo como aquela situada em área rural ou aquela situada em área urbana que atende, predominantemente, populações do campo. Diante disso, é notório que são os sujeitos que determinam a identidade desse tipo de instituição escolar.

Neste sentido, Caldart (2004) destaca que as escolas do campo têm suas identidades diretamente relacionadas aos sujeitos que dela usufruem, ou seja, pequenos agricultores, pescadores, povos indígenas, extrativistas, assentados e vários outros sujeitos que vivem nas comunidades do campo e que frequentam as escolas rurais como espaço de desenvolvimento intelectual.

Sendo assim, devem ser respeitados os valores, as diversidades e a identidade desses sujeitos, envolvendo essas particularidades no processo de ensino-aprendizagem das escolas do campo.Ou seja, é imprescindível que a educação do campo seja pensada a partir da interculturalidade, envolvendo o contexto e as multidimensões da comunidade local às práticas educacionais, possibilitando a elaboração de projetos e planejamentos que considerem a diversidade sociocultural dos campesinos, além de influenciar na formação de cidadãos críticos capazes de atuar de maneira efetiva e significativa na sociedade onde vivem.

Partindo dos pressupostos acima,temos como objetivo discutir práticas educativas interculturais que devem ser desenvolvidas nas escolas do campo, por meio do debate sobre a construção de projetos de ensino que se pautem na oferta de uma educação transformadora. Inicialmente,discorremos a respeito da educação do campo, destacando sua fundamentação legal. Posteriormente, abordamos o conceito de interculturalidade relacionado às práticas educativas. Por fim, discutimos a importância das práticas educativas interculturais no contexto da educação do campo.

II. METODOLOGIA

De acordo com Koche (2011, p.123), a pesquisa bibliográfica “se desenvolve tentando explicar um problema, utilizando o conhecimento disponível a partir das teorias publicadas em livros ou obras congêneres”. Sendo assim, metodologia a ser utilizada neste estudo envolve uma revisão bibliográfica, desenvolvida a partir da leitura, interpretação de livros e demais publicações sobre o tema, para estabelecer de maneira sistematizada os conceitos e opiniões defendidas.

III. EDUCAÇÃO DO CAMPO

A educação do campo é um dos temas que merece destaque, haja vista a luta pela equidade e pela garantia de uma educação de qualidade são fatores que possibilitam caminhos para a inserção no mundo globalizado. Dessa maneira, discutir Educação do Campo pressupõe uma problematização de seus dispositivos legais.

Em nosso país já há significativos dispositivos que auxiliam na fundamentação e implementação de políticas públicas especificas para a Educação do Campo e para o atendimento das demandas dos trabalhadores do campo. Ou seja, já há instrumentos reguladores de Estado que servem de base no cenário nacional, para a construção de projetos de ensino alternativos e que se pautem na oferta de uma Educação do Campo transformadora, e nas suas interfaces com os Povos e Comunidades Tradicionais (CPT’s) (Indígenas, quilombolas, ribeirinhos, extrativistas, ciganos, pomeranos etc.).

Sendo assim, podemos destacar algumas conquistas legais que abrangem a educação do campo, tal como a Constituição Federal de 1988, a Resolução CNE/CEB nº 1, de 3 de abril de 2002, o Decreto nº 7.352 de 2010, LDB/96, entre outros atos normativos que servirão de base para a fundamentação deste estudo.

A Constituição Federal de 1988, em seu artigo 205, dispõe que a educação é um direito de todos os cidadãos e é um dever do Estado e da família, dessa forma, temos um direito que precisa ser assegurado. Mas, para que isso seja possível, é necessário que a escola do campo venha a ser planejada, organizada e avaliada com a participação dos sujeitos que a demandam, no caso, as populações camponesas, para que seja garantida uma educação de qualidade e democrática.

Dessa forma, os autores Miguel Arroyo e Bernardo Fernandes (1999, p. 30) enfatizam que é necessário “ir às raízes culturais do campo e trabalhá-las, incorporá-las como herança coletiva que mobiliza e inspira lutas pela terra, pelos direitos, por um projeto democrático” de ensino.

Seguindo a Constituição Federal de 1988, porém, de forma mais específica a Resolução CNE/CEB nº 1, de 3 de abril de 2002, estabelece as Diretrizes Operacionais para a Educação Básica nas escolas do campo que constituem um conjunto de princípios e de procedimentos a serem observados nos projetos das instituições que integram os diversos sistemas de ensino do campo. Estes projetos devem, então, garantir uma gestão democrática, por meio de mecanismos que estabeleçam relações entre a escola, a comunidade local, os movimentos sociais, os órgãos normativos do sistema de ensino e os demais setores da sociedade.

De acordo Miguel Arroyo (2004, p.23) a educação do campo:

> precisa ser uma educação específica e diferenciada, isto é, alternativa. Mas, sobretudo deve ser educação, no sentido amplo de processo de formação humana, que constrói referências culturais e políticas para intervenção das pessoas e dos sujeitos sociais na realidade, visando a uma humanidade mais plena e feliz.

Desse forma, devemos pensar a escola do campo como espaço de um projeto educativo de práticas emancipatórias, ou seja, ela não deve ser como um lócus de um único saber aceitável, pois a partir do momento que a educação não é relacionada às relações de produção, à cultura e aos valores éticos, não acontecerá a emancipação intelectual, social e política (EVANGELISTA, 2017), pois o que vigora é a ideia de um sujeito, o "aluno", mero receptor de conhecimento, que pode ser educado a partir de uma perspectiva generalista.É importante ressaltar, que "educando não é meroespectador e o educador um arrumador de cenário ou sábio, pois ambos trabalham naconstrução do novo" (RAMOS, 2012, p.288), na construção do conhecimento.

De acordo com ROCHA e MARTINS (2011) a Educação do Campo vai além dos muros da escola, alcançando os sujeitos no seu fazer cotidiano, por meio das suas representações sociais. Sendo assim podemos afirmar que a educação do campo é uma importante modalidade de educação escolar inclusiva que pode fazer do processo de escolarização um espaço de emancipação da população rural brasileira, respeitando a diversidade, os valores e a identidade.

Neste sentido, a Lei de Diretrizes e Bases da Educação Nacional (LDB) nº 9.394, de 20 de dezembro de 1996, enfatiza em seu artigo 28 que:

> Art. 28. Na oferta de educação básica para a população rural, os sistemas de ensino promoverão as adaptações necessárias à sua adequação às peculiaridades da vida rural e de cada região, especialmente:
>
> I - conteúdos curriculares e metodologias apropriadas às reais necessidades e interesses dos alunos da zona rural;
>
> - organização escolar própria, incluindo adequação do calendário escolar às fases do ciclo agrícola e às condições climáticas;
>
> III- adequação à natureza do trabalho na zona rural.

Este artigo da LDB/96 pode ser considerado uma conquista para educação do campo ao prever que as especificidades desta educação devem ser consideradas. Mas, apesar disso, podemos considerá-lo também como insuficiente por dispor que no sistema de ensino rural devem ser promovidas "adaptações necessárias à sua adequação", o que estabelece uma margem para a mera adaptação do serviço educacional oferecido na cidade para o campo, quando na verdade, o que deve ser feito é a criação e a oferta de serviços específicos para o campo.

Diante disso, a educação do campo deve se propor a se constituir dos valores dos sujeitos do campo, sendo planejada, desenvolvida e avaliada com a participação desses, pois são eles que a demandam, devendo construir suas vidas em conjunto, pensando e agindo para melhorar suas existências. Como bem argumenta Freire (1987), a práxis é reflexão e ação dos homens sobre o mundo para transformá-lo. Sem ela, é impossível a superação da contradição de opressor oprimido.

Neste sentido, o art. 3º da Resolução CNE/CEB nº 1, de 3 de abril de 2002, dispõe sobre a magnitude da importância da educação escolar para o exercício da cidadania plena e para o desenvolvimento de um país, devendo ter como referências a justiça social, a solidariedade e o diálogo entre todos, independentemente de sua inserção em áreas urbanas ou rurais.

Em resumo, a Educação do Campo deve dialogar com a teoria pedagógica desde a realidade particular dos camponeses se preocupando com a educação do conjunto da população do campo e, mais amplamente, com a formação humana. Sobretudo, trata-se de construir uma educação do povo do campo e não apenas com ele ou para ele (PICCIN; BETTO 2017).

IV. INTERCULTURALIDADEE EDUCAÇÃO

Homens e mulheres vivem em sociedade em meio a uma grande diversidade cultural, e entre essas culturas existem fronteiras que provocam certos distanciamentos, incompreensões, exclusões e até mesmo guerras. Dessa maneira, reconhecidamente essas barreiras precisam ser rompidas, em um exercício de respeito às diferenças e de percepção do outro como cidadão, com direito as suas singularidades.

Diante disso, o grande questionamento é: como quebrar e ultrapassar essas fronteiras que se estabeleceram ao longo da história, e têm por base visões ideológicas, subjetivas, culturais, políticas e econômicas? Inicialmente, podemos dizer que não se trata de uma tarefa fácil, muito menos rápida, pois se trata de um processo que passará

pela educação, pela cultura, por mudanças individuais e coletivas que possibilitem desmistificar preconceitos, padrões, falsas premissas, subjetividades, intolerâncias e atitudes estigmatizadoras.

Apesar de a escola ter exercido, durante um longo período, um papel de grande influência no processo de homogeneização cultural, "tendo por função difundir e consolidar uma cultura comum de base ocidental e eurocêntrica, silenciando e/ou inviabilizando vozes, saberes, cores, crenças e sensibilidades" (CANDAU, 2010, p. 154), é válido ressaltar, queela mesmo assim, se configura como uma das principais ferramentas para a superação dessas práticas.

Dessa forma, a escola deve assumir o desafio de romper com essas barreiras e construir pontes que levem a uma relação harmoniosa entre pessoas, religiões, formas de ver e de viver as diferenças. Para tanto, ela precisa desconstruir essas práticas homogeneizadoras que não reconhecem as diferenças enquanto contribuições para a construção dos conhecimentos e que utiliza projetos, currículos e práticas que privilegiam e hierarquizam pessoas, gostos, raças, culturas, etc.

Para Ramos (2012, p. 273) devemos pensar a educação a partir da filosofia ético-libertadora, pois ela "busca estabelecer uma relação entre os sujeitos que não se configure uma relação de domínio ou uma relação de poder dessas que margeiam sempre o abismo de retorno à barbárie e à violência". O autor enfatiza ainda que devemos firmar o outro como alteridade, ao qual se deve todo respeito e a quem se reconhece ser completamente distinto.

Dessarte, é preciso construir novas formas de observar, interpretar e agir diante da diversidade humana e cultural. Estudos de muitos autores da contemporaneidade têm contribuído para um repensar das práticas pedagógicas a partir da perspectiva intercultural. E de acordo com Fleuri (2005)a intercultura indica um complexo campo de debate entre as variadas concepções e propostas que enfrentam a questão da relação entre processos identitários socioculturais diferentes, focalizando especificamente a possibilidade de respeitar as diferenças e de integrá-las em uma unidade que não as anule.

O autor acrescenta ainda que em todos os movimentos e práticassociais e educacionais, que propõem uma convivência democrática entre diferentes grupos sociais e culturas, o trabalho intercultural tem como objetivo principal de "contribuir para superar tanto a atitude de medo quanto a de indiferente tolerância frente ao «outro», construindo uma disponibilidade para a leitura positiva da pluralidade social e cultural" (FLEURI, 2005, p. 93).

Dessa maneira, segundo Fleuri (2003, p.31) a educação intercultural leva em consideração as relações entre seres humanos culturalmente diferentes uns dos outros e não busca somente apreender o caráter de várias culturais, mas, sobretudo, busca:

> compreender os sentidos que suas ações assumem no contexto de seus respectivos padrões culturais e na disponibilidade de se deixar interpelar pelos sentidos de tais ações e pelos significados constituídos por tais contextos [...]. Nesta óptica, o reconhecimento das complexas e conflitantes relações interculturais pode ser fundamental para reverter os processos de exclusão estabelecidos pela adoção de mecanismos culturais hegemônicos que perpassam a escola e transformam em estrangeiros muitos sujeitos sociais.

Em complemento, Candau (2014, p.1) também conceitua o que seria de educação intercultural e destaca que ela parte da diferença como riqueza e:

> promove processos sistemáticos de diálogo entre diversos sujeitos – individuais e coletivos –, saberes e práticas na perspectiva da afirmação da justiça – social, econômica, cognitiva e cultural assim como da construção de relações igualitárias entre grupos socioculturais e da democratização da sociedade, através de políticas que articulam direitos da igualdade e da diferença.

Diante disso,então, podemos considerar que a educação intercultural se estabelece, na realidade, como um novo ponto de vista baseado no respeito às diferenças, que se concretiza, até mesmo, no reconhecimento da paridade de direitos.É válido ressaltar, que essa problemática vem trazendo diversos questionamentos para o campo da educação no Brasil, que vem respondendo com estudos e propostas que visam à incorporação da perspectiva intercultural no cotidiano escolar.

A exemplo disso, tivemos nas últimas décadas o desenvolvimento de alguns programas, leis e diretrizes voltados à promoção da educação intercultural, tais como: as Diretrizes Curriculares Nacionais para Educação Indígenas de 1999; Diretrizes Operacionais para a Educação Básica nas Escolas do Campo de 2002; Diretrizes Curriculares Nacionais para a Educação das Relações Étnico-raciais e para o Ensino de História e

Cultura Afro-brasileira e Africana de 2003; e as Diretrizes Curriculares Nacionais para a Educação Escolar Quilombola de 2012, entre outros.

A partir disso, podemos perceber que houve avanços significativos no Brasil na afirmação dos direitos dos grupos sociais "minoritários" com a promulgação dessas leis e diretrizes e outros atos normativos, que vão tanto na direção do combate aos preconceitos étnico-raciais, religiosos, dentre outros, quanto na valorização e afirmação dos direitos e das práticas culturais das populações historicamente excluídas, a exemplo dos povos do campo.

Portanto, é imprescindível à promoção de práticas educativas que reconheçam as diversidades culturais e os diferentes saberes como forma de garantir a formação de cidadãos capazes de interagir e de negociar objetivos comuns que garantam, a todos, respeito aos direitos legais e valorização de identidade, na busca da consolidação de uma escola e de uma sociedade democrática e justa.

V. A IMPORTÂNCIA DE PRÁTICAS INTERCULTURAIS NO CONTEXTO DAS ESCOLAS DO CAMPO

Grande parte dos projetos educativos que são desenvolvidos nas escolas do campo se baseiam em um ideal pedagógico associado à racionalidade técnica, ou seja, utilizam modelo/padrão de educação centrado na reprodução de conhecimentos e valores tidos como "verdades universais", vinculados às matrizes culturais "eurocêntricas". Dessa forma, as práticas educativas instituídas neste contexto trazem as marcas de uma pedagogia autoritária e colonizadora, na medida que, ignoram e/ou silenciam os saberes e as experiências culturais desses povos, promovendo assim, a desvalorização do campo enquanto local de produção de cultura e de conhecimento.

Assim sendo, Candau (2016, p.807) aponta que:

> Parece que há uma única e verdadeira maneira de se pensar a escola, seus espaços e tempos, sua lógica de organização curricular, sua dinâmica e, até mesmo, sua decoração e linguagem visual. Tudo parece concorrer para afirmar a homogeneização e padronização. Acreditamos que somente avançaremos na construção de uma qualidade adequada aos tempos atuais se questionarmos essa lógica. Caso contrário, continuaremos enfatizando medidas paliativas e cosméticas.

Podemos afirmar então que a nossa tradição social de maneira geral inspira-se em uma visão generalista de direitos, de cidadania, de educação, de igualdade que ignora as diferenças de território, etnia, raça, gênero, classe, e é justamente isso que precisa ser superado, pois as escolas do campo têm autonomia para elaborar seu próprio projeto escolar e é importante que não só valorizem o contexto cultural no qual estão inseridos seus estudantes, como também incluam os saberes rurais e as tradições locais em todo o processo de ensino-aprendizagem em desenvolvimento nestas escolas.

Ou seja, é de suma importância que o projeto de escola seja articulado a realidade do aluno, ao meio cultural e social onde ele vive, a sua linguagem, aos seus meios de produção, enfim, ao conhecimento próprio adquirido das relações e da convivência em comunidade. Sendo assim, esta escola precisa ser planejada, desenvolvida e avaliada com a participação dos sujeitos que a demandam, no caso, as populações camponesas.

Morin (2000) afirma o conhecimento a partir de informações ou dos dados isolados é insuficiente. Sendo assim, é preciso situar as informações e os dados em seu contexto para que adquiram sentido. O autor acrescenta ainda que, atualmente, há uma hegemonia dos princípios de redução e de disjunção no ambiente educacional, cujo conjunto constitui o paradigma de simplificação.

No contexto da educação do campo, as reduções se configuram quando restringimos toda complexidade humana (particularidades, identidade, cultura, tradições...), simplificando tudo isso a um modelo cultural e educacional homogeneizador, que serve de padrão neste ambiente educacional, tratando tudo como algo mecânico. A partir disso, podemos visualizar as disjunções no isolamento radical dos campos do conhecimento, na uniformização de currículos, de conteúdos e até mesmo de didáticas educacionais, que se desconectam cada vez mais das particularidades desses sujeitos da comunidade.

Dessa forma, chegamos, segundo Morin (2000), à inteligência cega, que aniquila os conjuntos e as totalidades, afasta todos os objetos do seu meio ambiente, tornando as realidades desintegradas. Sendo assim, este se configura como um dos principais desafios enfrentados pelas escolas do campo.

Neste sentido Gadotti (2011, p. 61) destaca que:

> Todo ser vivo aprende na interação com o seu contexto: aprendizagem é relação com o contexto. Quem dá

> significado ao que aprendemos é o contexto. Por isso, para o educador ensinar com qualidade, ele precisa dominar, além do texto, o "com-texto"; além de um conteúdo, o significado do conteúdo que é dado pelo contexto social, político, econômico, histórico...

Por isso é imprescindível que a educação do campo seja pensada a partir de um ponto de vista intercultural, envolvendo o contexto e as multidimensões da comunidade local às práticas educacionais, possibilitando a elaboração de projetos e planejamentos que considerem a diversidade sociocultural dos campesinos, além de influenciar na formação de cidadãos críticos capazes de atuar de maneira efetiva e significativa na sociedade onde vivem.

E de acordo Gadotti (2012) é preciso ter coragem para transformar essa realidade educacional, portanto, não podemos aceitar modelos educacionais prontos e acabados, que não estejam de acordo com a realidade dos alunos e não respeitem suas diferenças. O autor destaca também o papel fundamental dos professores nestas mudanças, conscientizando os educandos a serem críticos e participativos, e que estes atuem como agentes passivos/ativos, receptores e produtores de conhecimento juntamente com os docentes.

É válido ressaltar que a partir das práticas educacionais interculturais, as escolas do campo podem adquirir respeito, equidade e engajamento social em relação aos outros projetos educacionais no panorama educativo brasileiro. A modalidade educacional tradicional, difundida em escala "industrial', e impositiva, apresentaabordagens pedagógicas fora da realidade sensível dos alunos do campo. Ademais, até o próprio material didático carece de ser repensado a partir da cultura local, claro, com um pertinente diálogo com as demais manifestações culturais.

É evidente que sensibilidade para as questões relacionadas às diferenças culturais vem aumentando na sociedade e nos mais diversos contextos educativos. Mas, são muitos os desafios para se desenvolver uma educação intercultural nas nossas escolas do campo, especialmente se assumimos a perspectiva da interculturalidade crítica ao qual Candau (2016, p.808) atribui as seguintes características:

> promove a deliberada inter-relação entre diferentes sujeitos e grupos socioculturais de determinada sociedade; nesse sentido, essa posição se situa em confronto com todas as visões diferencialistas, assim como com as perspectivas assimilacionistas; por outro lado, rompe com uma visão essencialista das culturas e das identidades culturais; concebe as culturas em contínuo processo de construção, desestabilização e reconstrução; está constituída pela afirmação de que nas sociedades em que vivemos os processos de hibridização cultural são intensos e mobilizadores da construção de identidades abertas, o que supõe que as culturas não são puras, nem estáticas; e tem presente os mecanismos de poder que permeiam as relações culturais, assumindo que estas não são relações idílicas, estão construídas na história e, portanto, estão atravessadas por conflitos de poder e marcadas pelo preconceito e discriminação de determinados grupos socioculturais.

Diante disso, a partir dessa perspectiva da interculturalidade crítica, precisamos superar uma maneira estereotipada e superficial de tratar esse tema nas escolas do campo, que é muitas vezes reduzido à incorporação de expressões culturais em momentos específicos, em geral, em comemorações de datas previstas no calendário escolar.

Portanto, Educação do Campo como prática do diálogo intercultural mobiliza-nos para a construção coletiva de um projeto de educação que não fica restrito ao espaço escolar e que tem por base outros paradigmas escolares, outras formas de organizar os currículos, os espaços e tempos, o trabalho docente, as relações com as famílias e comunidades, de conceber a gestão de modo participativo, enfatizando as práticas coletivas, a partir de um conceito amplo e plural de sala de aula, etc.

VI. À GUISA DE CONCLUSÃO

Apesar dos retrocessos dos últimos tempos, principalmente no campo ideológico, que afetaram drasticamente as políticas públicas direcionadas para a área da educação no Brasil, é preciso insistir em práticas escolares que se firmem na interculturalidade, que tragam para as escolas do campo o contexto e as multidimensões de suas comunidades, dando sentido às práticas educativas, possibilitando a elaboração de projetos e planejamentos que considerem a diversidade sociocultural dos campesinos, e que corroboram para a formação de

cidadãos críticos capazes de atuar de maneira efetiva e significativa na sociedade onde vivem.

É necessário, então, realizar experiências pedagógicas a partir dos mais diversos paradigmas educacionais, bem como construir novas propostas educativas, que sejam mais coletivas e plurais, pois a educação do campo, sustentada em uma base intercultural, é uma das ferramentas fundamentais para a construção de uma sociedade democrática, justa e inclusiva, que articule políticas de igualdade com políticas de identidade.

Portanto, consideramos importante que a escola se reinvente a partir de práticas interculturais, com promoção de diálogos entre culturas e saberes convergentes, para que ela possa responder de forma efetiva os diversos desafios impostos pela sociedade que vivemos. Logo, devemos deixar para trás o projeto hegemônico de educação ditado pelas elites nacionais e internacionais, que utiliza práticas precárias e incompletas, que incentivam a padronização, a unificação de currículos e de perspectivas que reduzem o direito à educação a resultados uniformes.

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Direct Costs of Parkinson's disease in Brazil: A case study

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***Abstract*—** *The lack of studies on the costs of Parkinson's disease in Brazil makes it difficult to predict the costs of treatment, making it impossible to assess the economic impact on the individual's life and on health systems. The objective of this research is to estimate the average annual cost of treating Parkinson's Disease in users of the Public Health System in the city of Niterói (RJ), based on the variables Direct Cost. Methods: The research followed a mixed methods design, with qualitative and quantitative data, obtained through interviews with a sample of 54 patients and analyzed through non-parametric tests due to the rejection of the normality of the numerical data sets obtained. Results: Eleven direct cost variables were identified in the literature with the treatment of the disease, with 84.5% of the total cost concentrated in four of them (Drugs, Hospitalizations, Home Care and Auxiliary Treatments). There is a difference between patient costs and degree of illness for the public and private categories. Groups did not differ from each other when these costs were related to gender, race, education level and current employment. The mean total annual cost was estimated at R$14,293.6 (US$2,904.8) and calculated from the mean and 95% confidence interval obtained. Conclusion: The estimation of individual costs with the treatment proved to be of fundamental importance for understanding the total costs, and justifies the importance of studies in this area, both for patients and for managers involved in health care.*

I. INTRODUCTION

In recent years, the aging of the world population, the effects of urbanization and globalization, and the increased incidence of numerous diseases have contributed to the growth in patients with chronic conditions, such as neurological diseases[1] . The incidence of diseases is expected to increase as the population ages, once the aging process is a significant risk factor[2]. The challenges of accurate diagnosis and delivery of health care profoundly impact individuals, their families and communities, the general health system, and governments [3].

Parkinson's Disease (PD) stands out in this scenario, a chronic and degenerative neurological condition that mainly affects the elderly, causing important vital incapacities and reduced quality of life. This disease is the

second common neurodegenerative disease after Alzheimer's and the main burden on the patient, family, caregivers, and the healthcare system[4,6].

Neurodegenerative diseases that are impossible to prevent, such as PD, are often associated with a significant burden borne by society, whether financial, social, or psychological[7]. As the disease progresses, patients face an increasing severity of symptoms, reflecting increased treatment costs[8].

The financial impact of PD on society has been widely discussed in recent decades. Research has indicated a more significant effect in the current future, associated with an aging population[9]. However, the scarcity of studies on the cost of PD in Brazil makes it difficult to forecast and consequently assess the economic impact of PD on the individual's life and both in public and private health systems.

Determining the costs of disease makes it easier to understand its impact on society and health systems, assessing its degree of efficiency and understanding how the market tends to organize itself concerning specific values[7]. Therefore, based on the main Direct Cost variables, this case study aims to determine the average annual cost of PD treatment among patients who use the Public Health System in the city of Niterói (RJ, Brazil).

II. MATERIALS AND METHODS

Participants

A total of 59 patients were contacted between March and November 2020 during outpatient consultations at the Hospital Universitário Antônio Pedro (HUAP). Patients physically or cognitively incapable of answering the questionnaire (n = 5) were excluded from the sample. All others consented to participate in the survey, resulting in a total of 54 interviews. Before participating in this study, participants signed a written consent after receiving a detailed explanation of all steps of the research protocol. According to the Declaration of Helsinki, all efforts were carried out and approved by the Research Ethics Committee of the Universidade Federal Fluminense (CAAE: nº 3.687.239.)

Study procedures

The questionnaire, an instrument used for this research and consisting of 33 questions, was divided into three parts: 1) Introduction, with a presentation by the researchers and a brief contextualization of the theme and research objectives; 2) Screening, with questions that determine the profile of respondents; and 3) Identification of Treatment Costs, covering the variables: consultation, medication, auxiliary treatments, hospitalization, home care, exams, transport, food, home adaptations, surgery, and special equipment. Such variables, identified in the literature on the subject, make up the Direct Costs with PD treatment. The Hoehn and Yahr Scale (HY – Degree of Disability Scale) was used to classify the stage of disease progression. In this modified format, the scale comprises seven steps of classification to assess the severity of PD and essentially encompasses global measures of signs and symptoms that allow classifying the individual as to the level of disability [18]. This was an observational, cross-sectional, retrospective study about disease prevalence that used a bottom-up approach (i.e., society's perspective). The time horizon used was six months. The study viewpoint was first carried out from the patient's perspective and then evaluated from the Public Health System prospect.

Cost calculation

Costs were calculated for the period of 6-months before the interview and extrapolated to 1 year. The amounts are described in reais ($) and US dollars (USD) using the Central Bank real-dollar quotation assessed on June 25, 2021. The research on the value of medical consultations and other cost variables that fall on the public health system was carried out in the database of the Ministry of Health of Brazil, known as the Sistema Único de Saúde (SUS; www.datasus. gov.br and http://sigtap.datasus.gov.br). Access to the portal was carried out on January 16, 2021. At the research time, the average market price was estimated for patients who purchased medications in pharmacies or private drugstores. In cases where private therapists were hired, consultation fees were obtained directly from the professionals. For the other variables, the patient was asked immediately about the values practiced.

Statistical analysis

The statistical description of the data was performed using tabular methods (statistical tables and summary tables of information). Absolute frequencies and proportions were used for categorical variables. For numerical variables, data were expressed as means accompanied by the standard deviation (as mean ± SD). The normality of cost distribution, assessed by the Kolmogorov-Smirnov test, was rejected. Therefore, the Mann–Whitney U test was applied to independent samples, while the Wilcoxon signed-rank to paired samples. For more than two independent groups, the Kruskal-Wallis test was performed. The generalized linear model with gamma probability distribution and log link function were used to estimate the total annual cost. A significance level of 0.05 (5%) was adopted and the analyzes were conducted using R[19].

III. RESULTS

Descriptive analyses

Demographic and clinical characteristics of the participants are detailed in Table 1. Males represent 64.8% of the sample, 50% of patients had completed elementary school, 88.9% were retired, 48.1% of patients had an HY score of 3 or 4 and 82.6% of patients had the disease for more than 5 years. The average monthly income of the sample was R$ 4,460.4 (US$ 906.52) and median R$ 2,455.00 (US$ 498.92).

Table.1: Patient caracteristics

Gender, n (%)	
Male	35 (64.8)
Race, n (%)	
White	28 (51.9)
Black	5 (9.3)
Multiracial	21 (38.9)
Age (years), mean ± sd	69.2±10.7
Education level, n (%)	
Never attended school	1 (1.9)
Completed grade school	27 (50.0)
Completed middle school/high school	15 (27.8)
Completed college	7 (13.0)
Completed graduate school	4 (7.4)
Current employment, n (%)	
Retired	48 (88.9)
Income (US$), mean ± sd	906.52±792.38
Hoehn and Yahr scale, n (%)	
1	3 (5.6)
1.5	2 (3.7)
2	10 (18.5)
2.5	5 (9.3)
3	14(25.9)
4	12 (22.2)
5	8 (14.8)
Disease duration, (years), n (%)	
≤5	9 (16.7)
6−14	28 (51.9)
≥15	17 (31.4)

The distribution of the total biannual cost of PD treatment, considering the direct cost variables, is described in Table 2. Although composed of patients undergoing treatment in the public health system, the study sample presents values associated with costs distributed in two categories: private and public. Note that medications, hospitalizations,

caregiver services and secondary treatments account for 86.4% of the total costs. When analyzing the cost categories, it is possible to observe that, in private system, the main expense is medications (37.3%). On the other hand, hospitalizations in the public health system stand out with 45.5% of total costs.

Table. 2: Distribution of the 6-months costs of PD treatment

Costs US$ (%)	Categorie		Total
	Private	Public	
Direct medical costs			
Medical visits	0.0 (0.0)	1,100.9 (2.2)	1,100.9 (1.1)
Medications	17,987.2 (37.3)	20,452.4 (41.7)	38,439.6 (39.6)
Secondary treatments (*)	8,803.8 (17.9)	840.1 (1.7)	9,643.9 (9.7)
Surgery	0.0 (0.0)	3,707.2 (7.6)	3,707.2 (3.8)
Hospitalizations	0.0 (0.0)	22,346.7 (45.5)	22,346.7 (23)
Caregiver services	13,656.8 (28.4)	0.0 (0.0)	13,656.8 (14.1)
Medical exams	0.0 (0.0)	621.7 (1.3)	621.7 (0.6)
Direct nonmedical costs			
Transport	776.4 (1.6)	0.0 (0.0)	776.4 (0.8)
Food	3,901.9 (8.1)	0.0 (0.0)	3,901.9 (4.0)
Home adaptations	2,040.4 (4.2)	0.0 (0.0)	2,040.4 (2.1)
Equipment to facilitate locomotion	1,225.2 (2.5)	0.0 (0.0)	1,225.2 (1.3)
Total	**48,391.7 (49.6)**	**49,069.0 (50.4)**	**97,460.7 (100)**

Essential as a non-pharmacological therapy, secondary treatments (Physiotherapy, Speech Therapy, Occupational Therapy, Psychologist, Nutritionist and Physical Activity) had a high number of prescriptions among the investigated patients (79.6%). Nevertheless, 41.9% of patients indicated for these treatments did not undergo them due to difficulties scheduling these therapies in the public health system. Among the treatments most frequently prescribed, physiotherapy and physical activity stand out.

The variables medical visits and exams, vital for the treatment and monitoring of the evolution of PD, do not have a large representation in the total cost of treatment (1.1% and 0.6%, respectively). These variables had their costs added to the public health system, and this fact is justified due to the profile of the sample.

Other variables, such as home adaptations, equipment to facilitate locomotion and transport, presented interesting biases that hampered the calculation of their respective average costs, and this fact certainly underestimated the total cost estimate with these variables.

Inferential analyses

The Figure 1 shows the distribution of the 6-months costs of degree of illness (HY scale) for both categories, private and public (SUS), as well as the *p values* associated with the hypothesis tests to verify whether there is a difference in the median costs between the groups.

Clearly, there is a difference between patient costs and degree of illness for the two categories (private - $p = 0.021$; public - $p = 0.023$). In private, there is a difference between the groups mild and severe stages (Figure 1A). Furthermore, there is no difference between the costs of each category in relation to each of the stages (Figure 1B).

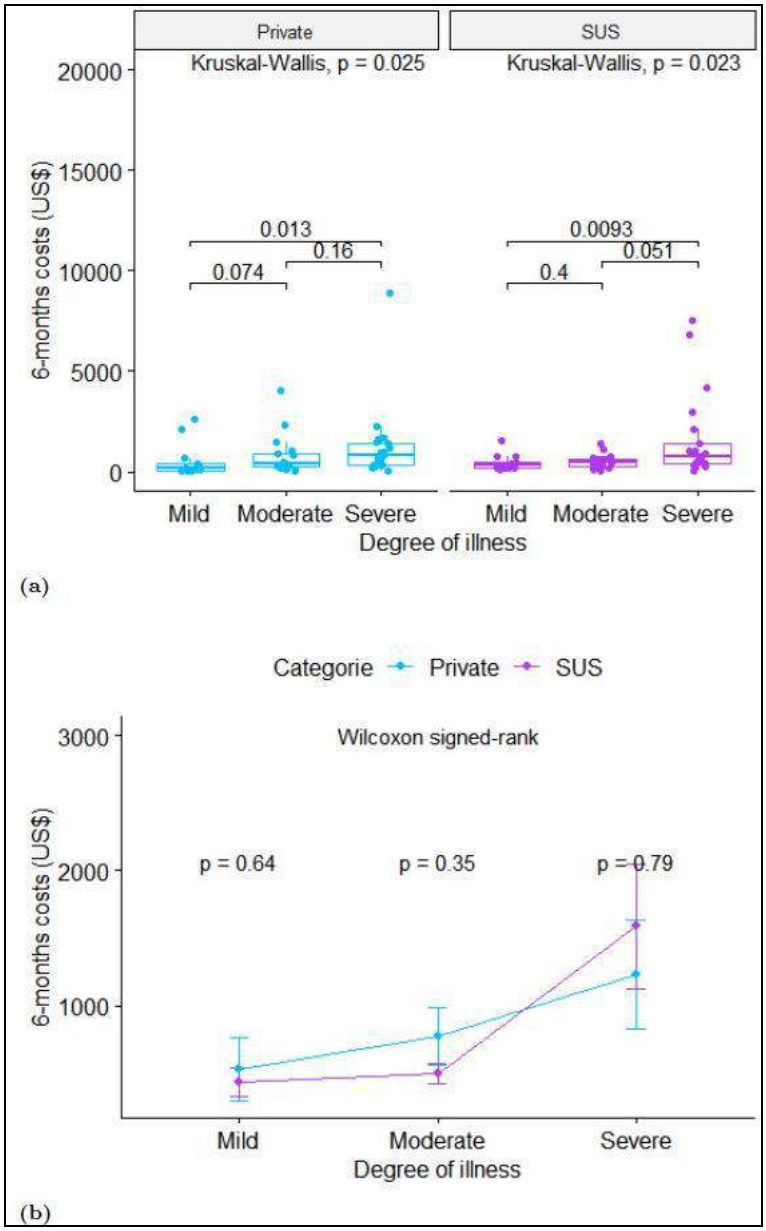

Fig.1: Comparison between degree of illness and 6-months costs.

(A) Comparison within each of the categories. (B) Comparison between categories.

Groups did not otherwise differ from each other when these costs were related with gender (p 0.08), race (p = 0.4), education level (p = 0.68) and current employment (p= 0.49). Age was significant (p = 0.02).

Table 3 shows the inferential analyses of the total annual cost of PD obtained by the generalized linear model. A step- by-step variable selection process that searched for the variable combination that best explains the total cost was applied resulting in following variables: medical visits, transport, caregiver services, hospitalizations, surgery, secondary treatments, medical exams, stage of disease progression and age.

Table.3: Estimated means and 95% CIs for the total annual cost of Parkinson's disease (US$)

Categories	Mean US$ (95% CI)	Total Cost (%)
Private	1,532.1 (1,087.1- 1,977.0)	82,734.7 (52.8)
SUS	1,372.7 (958.5 -1,786.9)	74,127.8 (47.2)
Total	**2,904.8 (2,215.5 - 3,594.1)**	**156,862.5**

These data revealed an average annual cost of R$14.293,6 (US$2,904.8) per patient ranged from R$10.901,9 (US$ 2,215.5) to R$17.685,4 (US$3,594.1). Furthermore, the total costs associated with both categories are similar. There is no statistically significant difference between them (p = 0.52).

IV. DISCUSSION

The cost analysis study carried out in this research is initially presented from the patient's perspective. The data collected in the quantitative phase was carried out through interviews with patients with PD who undergo treatment in the public health system. Using a retrospective time horizon of 6 months through the bottom-up valuation method and considering the prevalence and direct cost variables, an annual cost forecast for PD treatment was made.

Given the profile of the sample, it was expected that some variables, especially those related to direct medical cost, would concentrate their spending on public health system. In this research, we had 100% of the costs borne by public system in the variables medical visits, surgery, hospitalization and medical exams. This trend should not be extrapolated due to the size and characteristics of the sample. Still, they are an essential feature of this research and show an essential contribution in treating PD considering the adopted cost category (direct costs).

According to this scenario, it is possible to identify that 45.5% of the Direct Cost variables identified in the literature review and adopted in this study have their expenses (or part of them) added to the public health system. This represents a significant contribution to the patient's budget, given the socioeconomic characteristics of the studied sample.

Direct Costs comprise the total cost in health economic evaluation studies, being only part of this cost. Even so, its estimate is of fundamental importance for understanding total costs and justifies the importance of studies in this area, both for patients and for managers involved in health care.

In this case study, it was possible to diagnose that the allocation of public resources includes the main direct cost variables. Without estimating costs with the treatment of diseases, including PD, it is much more challenging to decide on allocating resources for the treatment. In the study environment covered by this research, for example, it was possible to observe a high cost of medicines and hospitalizations subsidized by the public health system, which corroborates the data collected in the literature review. Cost studies with the treatment of chronic diseases, such as PD, are increasingly needed as a tool to support decision-making, aiming at the sustainability of health systems.

The estimated average annual cost of PD treatment revealed that 52.8% of these costs fall on the patient and 47.2% fall on the public health system. However, the non-parametric Wilcoxon test revealed that this difference does not have statistical significance.

In a study carried out in Australia, to estimate the annual cost of PD treatment from the perspectives of the family, the health system and society, Bohingamu Mudiyanselage et al. [6] identified that two-thirds of the costs for the health system were related to Hospitalizations, with medical and pharmacological services contributing significantly to total costs. The study included 87 patients, assisted by the public and private health systems in that country. In another study, carried out in Singapore by Zhao et al.[17] , the authors identified pharmacotherapy and home care as the main components of the total cost. The sample consisted of 195 patients treated at the Center for Movement Disorders of the National Institute of Neurosciences in that country.

Medicines are the most frequently accumulated direct cost variable. Its expressive cost, which in this research represents 39.6% of the total direct cost, was also observed by Bovolenta et al.[7] in a study of a similar nature, carried out with patients also assisted by the public health system in the city of São Paulo. In this study, the authors identified that antiparkinsonian drugs accounted for 25% of the total cost (both drugs provided by the public health system and those purchased by patients) and 97% of direct medical costs. In a review study, Reese et al.[13] found that drug therapy accounted for 15% - 80% of total direct costs.

Hospitalizations have a high cost attributed to SUS due to the profile of the sample, composed of patients who undergo treatment for the disease in the public health system. No patient interviewed reported a case of admission to a private hospital. The high cost of admissions has already been identified in previous studies

on the cost of treating PD. However, the causes for such hospitalizations differ from the results found in this research.

A systematic review carried out by Koay et al. [12] pointed out as the main reasons for acute hospital admission in patients with PD falls, deterioration of motor and non-motor symptoms of the disease, cardiovascular events and infections, especially urinary tract infections and respiratory. The incidence of falls is also cited by Fundament et al. [11] and by Fletcher et al. [10] as being primarily responsible for cases of hospitalization among patients with PD.

In this research, the leading cause of hospitalizations cited by patients was surgeries performed to treat PD. Although only 11 patients underwent surgical interventions, some had postoperative complications and needed to extend the length of hospital stay, which significantly increased the costs with this variable. Besides that, 31.5% of the patients suffered some falls, but none resulted in hospitalization or need for medical care.

The high cost of formal home care, as demonstrated in the literature [4,6,7], falls directly on the patient since the public health system does not offer this type of service. Although reported by only five patients (9.3% of the sample), it is the third variable with the highest accumulated cost distribution identified in this research. The association between age and stage of disease progression had already been identified by Dodel et al. [16] and von Campenhausen et al. [15] and Martinez-Martín et al. [14] in previous studies, where the authors identified an increase in costs directly proportional to the degree severity of PD.

V. CONCLUSION

Considering this scenario, it is possible to identify that 45.5% of the Direct Cost variables identified in the literature review and adopted in this study have their expenses (or part of them) added to the public health system. This represents a significant contribution to the patient's budget, given the socioeconomic characteristics of the studied sample. Direct Costs make up the total cost in health economic evaluation studies, being only part of this cost. Even so, its estimate is of fundamental importance for understanding total costs, and justifies the importance of studies in this area, both for patients and for managers involved in health care. In this case study, it was possible to diagnose that the allocation of resources in the public health system includes the main direct cost variables. Without estimating costs with the treatment of diseases, including PD, it is difficult to decide on the allocation of resources for treatment.

Cost studies with the treatment of chronic diseases, such as PD, are increasingly needed as a tool to support decision-making, aiming at the sustainability of health systems. As proposals for further research, the replication of this study in a larger sample is suggested, with the possibility of generalizing the results. The possibility of comparing this cost analysis between patients treated in the public and private sectors is warranted. An analysis of the economic impacts of treatment, through a study of the costs of the same or similar nature, would also be interesting in the context of supplementary health.

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Risk of resident wildlife as the primary source of foot-and-mouth disease virus in Mato Grosso do Sul

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***Abstract*—** *The state of Mato Grosso do Sul is part of the Midwest region, its strategic position, its borders and its borders with many states are characteristics that require the State to pay special attention to the introduction, dissemination and maintenance of emergency diseases. The state, in addition to climate, vegetation and hydrography has a rich wildlife, mainly in the Pantanal region. The municipality of Corumbá is the first municipality in cattle herd. In this region the cattle production system is almost exclusively extensive with the use of native pasture. This combination: the breeding of commercial herd and proximity to the various wild species and susceptible to foot-and-mouth disease was the object of study, at a time when the State did not share the status of "free area". Studies conducted in the State, brazil, occasionally or experimentally, show that despite species susceptible to free living, the siids affected by the disease do not become carriers. The only species reported as carrier of foot-and-mouth disease is the African buffalo and does not exist in the country. Despite the need to develop other work with susceptible wild species, the effective control and eradication of foot-and-mouth disease began with the awareness of producers, emergency training given to the Official Service, vaccination campaign establishments, surveillance of properties, surveillance of events, surveillance in slaughter establishments and effective traffic control.*

I. INTRODUCTION

Mato Grosso do Sul (MS) is the fifth largest cattle producer in the country with a herd of 17,206,260 cattle, representing 9.08% of the total in Brazil. Even with the reduction of 13.18% of the herd, the State still maintains a relevant position. The municipality of Corumbá, in Mato Grosso do Sul, is in second place with the highest number of cattle heads per municipality, with 1.8 million. It is located in the Midwest region in a privileged position close to the major consumer centers and distributors of the country; it has borders with the states of Mato Grosso, Goiás, Minas Gerais, São Paulo, Paraná and also with two countries, Paraguay and Bolivia. This international border strip has an extension of approximately 700 kilometers, of which 300 kilometers without watertravel.

In the state of MS we find three important Brazilian biomes, the Cerrado, the Atlantic Forest and the Pantanal. They are biomes with rich biodiversity, resulting from influences from other forest formations and phytophysiognomies of other Brazilian regions, drained by important rivers such as Paraguay and Paraná [1]. It has two types of climate according to koppen classification: semi-humid tropical climate, which is present throughout the northern part of the state, with the presence of rain in summer and drought in winter and the tropical climate of altitude, present in the southern part of the state, where summer rains are more intense due to the action of the Atlantic tropical mass, in winter, cold fronts originating in the Atlantic polar mass can cause frosts.

Due to its strategic territorial location, the MS is part of Block IV of the Strategic Plan of the National Surveillance Program for Foot-and-Mouth Disease - PNEFA (2017-2026) and has commercial interests in raising the health status of "foot-and-mouth disease-free area with vaccination" to "foot-and-mouth disease-free area without vaccination".

Foot-and-mouth disease is an acute infectious disease caused by a virus belonging to the picornaviridae family, with high potential for transmission among susceptible animals, and may, in about a week or less, affect all the components of an affected herd. It is the animal disease that has the greatest repercussion worldwide, due to its high infection and contagiousness among animals, such as cattle, sheep, goats, pigs and wild biungulates, among which we can mention buffaloes, cervix, tapirs, capybara, bush pig, cateto, queixada and wild boar, all present in the state of Mato Grosso do Sul. Most wild animals are concentrated in conservation areas, especially the Pantanal Matogrossense National Park.

In Brazil, especially in the state of Mato Grosso do Sul, there are several species of wild animals susceptible to foot-and-mouth disease virus, but do not play the role of reservoir. Only the African buffalo (Syncerus caffer), nonexistent in Brazil, was considered a reservoir of the virus. Scientific studies show the presence of antibodies in wild animals, but there is no evidence that one population predominates as the origin of the infection for the other.

Thus, the objective of this work was to research and verify the level of risk that the wild fauna of Mato Grosso do Sul, being this source of natural infection of foot-and-mouth disease virus.

a) Geographic Description of Mato Grosso do Sul

The State of Mato Grosso do Sul, in the Midwest region of Brazil, has an extension of 357,145 km2. The state extends from the international borders with Paraguay and Bolivia, to the borders with the states of Mato Grosso, Goiás, São Paulo and Paraná in Brazil. The state is bordered by the Paraguay River to the south, southwest and north and the Paraná River to the east. It consists of two continuous geographical areas, formed by the pantanal plain, a large humid area with lots of natural vegetation, (~89,000 km²), and a plateau, originally covered by neotropical savannah and dry forest.

The State has several macroecosystems and the peculiar location and vegetation types found in it result in a biological diversity. Many species occur in the country, exclusively or almost exclusively in the south-mato-grossense territory, due to this peculiarity [5].

According to Koppen's classification, the climate of the State of Mato Grosso do Sul can be divided into two types: the semi-humid tropical climate and the tropical climate of altitude. The semi-humid tropical climate, predominant in the north of the State of Mato Grosso do Sul, has as a remarkable characteristic the presence of a rainy season in summer, in the period from November to April, and clear dry season in winter, from May to October (July is the driest month). The average temperature of the coldest month can exceed 18ºC. With precipitations exceeding 750 mm in the period of one year, and can reach up to 1800 mm. Emphasizing that this climate is typical of the savanna and cerrado areas. The tropical altitude climate, predominant in the south of the state of Mato Grosso do Sul, has temperatures above 22ºC in summer and with more than 30 mm of rain in the driest month. This climate has average temperatures between 18ºC and 22ºC and annual thermal amplitude between 7ºC and 9ºC [6].

The hydrographic basins, throughout their length, have ripe forests and are composed of a rich fauna of national and international prominence, being distributed throughout their territorial extension (Correntes, Taquari, Negro, Nabileque, Miranda, Apa, Apore, Sucuriu, Verde, Pardo, Invinhema, Amambai, Iguatemi, Santana and Quiteria) [7].

b) Main areas of concentration of wild animals

Mato Grosso do Sul has conservation areas such as the Environmental Protection Area Islands and Floodplains of the Paraná River, Serra da Bodoquena National Park, Emas National Park, Ilha Grande National Park and the Pantanal Matogrossense National Park, with abundance in wildlife in quantity of species and number of specimens.

The history of the implementation in Mato Grosso do Sul (MS) of conservation instruments and tools is very recent, in Brazil the state was one of the last members of the federation that created conservation units. However, more than a decade was set up until the creation of the first conservation unit of integral protection in Mato Grosso do Sul, materialized with the creation of the Várzeas do Ivinhema State Park, in December 1998, with 73,000 hectares, in the forest formations of the Atlantic Forest domain and wetlands, created as environmental compensation for the construction of the Sérgio Motta HOU, on the Paraná River[4].

c) Characterization of the Pantanal of Mato Grosso

The Pantanal is located in the Upper Paraguay Basin and has 138,183 km² in Brazilian territory – equivalent to 38.21% of the Paraguay River Basin area. In addition, it is widespread in Brazil (80%) between the states of Mato Grosso and Mato Grosso do Sul, with a small part in northern Bolivia (19%) and eastern Paraguay (1%) [9%).

In the study of Allem and Valls (1987) the division of, which affirm that the Pantanal is traditionally divided into limited areas by its main watercourses and by the nature of its historical occupation. The only exception was the separation of the Pantanal of Aquidauana and Pantanal de Rio Negro. Thus, the regions studied were: Pantanal of Nhecolândia, Pantanal of Abobral, Pantanal of Rio Negro, Pantanal of Aquidauana, Pantanal de Miranda and Pantanal of Nabileque. Other studies such as that conducted by Silva & Abdon (1998) considered aspects related to flooding, relief, soil and vegetation and defined the Pantanal region throughout the continuous area inserted in the Upper Paraguay basin, subject to periodic flooding, between years and within the same year (Fig. 1). The most recent study, by Mioto et. al (2012) does the analysis by photointerpretation of satellite images, which captured the entire Pantanal in a singleimage[8][10][11].

According to Suçuarana (2021) the pantanal fauna is quite diverse. Surveys recorded approximately 263 species of fish, 41 species of amphibians, 113 species of reptiles, 463 species of birds and 133 species of mammals being 2 endemic. The pantanal is also characterized, because it is rich in water, in this large ecosystem that is a great differential of the pantanal biome favoring the fauna, mainly due to the existence of several species of aquatic animals. Livestock, tourism and fishing are the main economic activities of the Pantanal. Deforestation that has been occurring in the pantanal has been the main threat to this biome and inadequate land management for agriculture, the construction of hydroelectric plants and urban and population growth contribute to this threat[12].

Most of the Pantanal is formed by private farms (about 95%) that develop beef cattle. Cattle ranching has been in the Pantanal for more than 200 years, with this, the Pantanal has been shaping the landscape units of the region with little impact, because the food base of cattle are the native forage resources (native pastures) and the optimization of production in the Pantanal must respect the limits of the environment, ensuring the maintenance of biodiversity and resilience (recovery capacity) of ecosystems[13].

The pantanal fauna is very diverse, including wetland deer, monteiro pig, wild boar and wild buffalo.

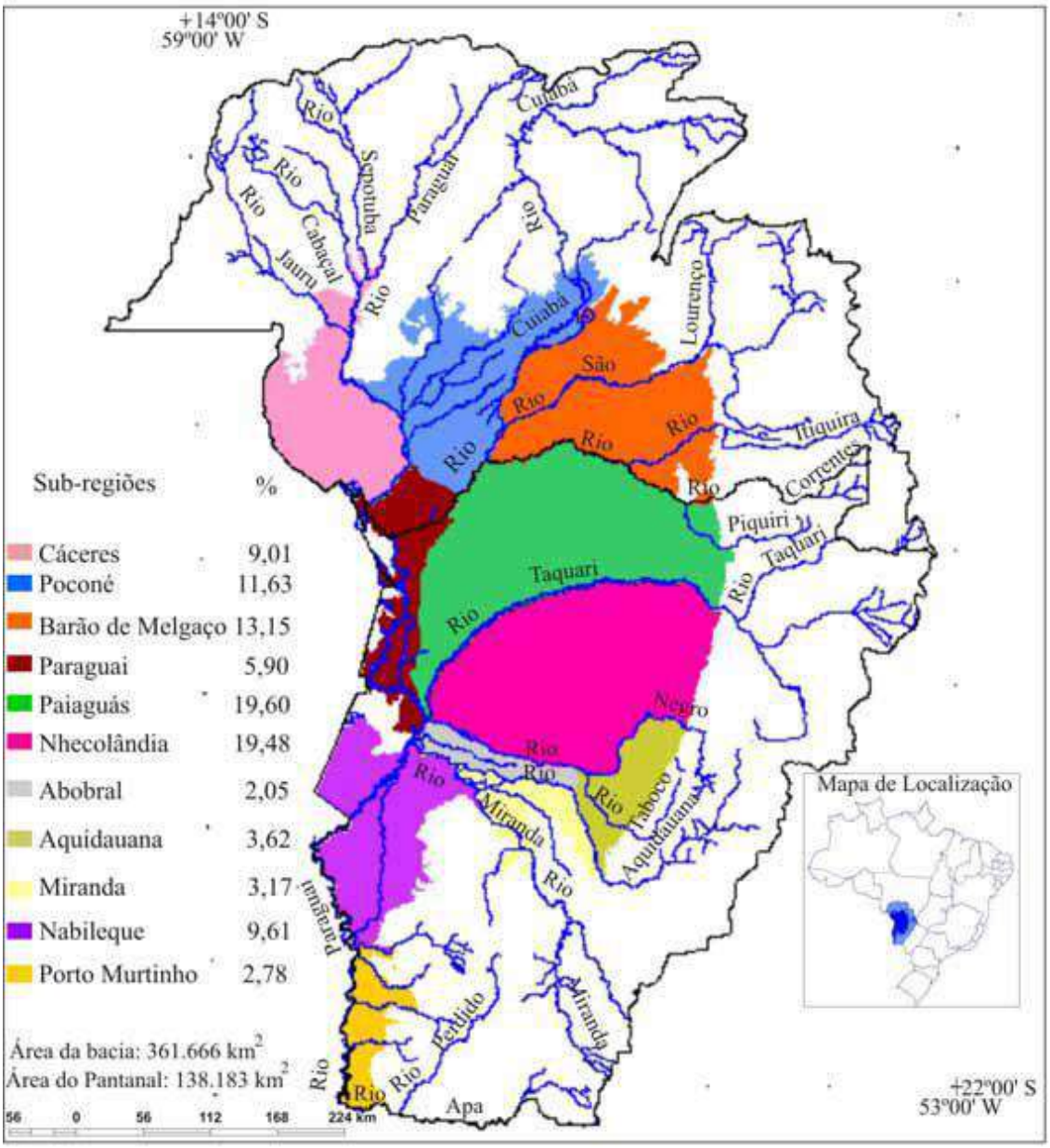

Fig. 1: Thematic map of the delimitation of the subregions of the Brazilian Pantanal. Upper Paraguay basin and Pantanal in Brazil, 1998. Source: SILVA & ABDON (1998)

d) FebreAftosa (Etiology and epidemiology)

Being considered as the main disease of mandatory notification foot-and-mouth disease is classified as a disease of list A of the International Health Code, it is a disease of high contagion rate, which puts agribusiness at risk, from countries where cattle ranching has economic importance[15].

Caused by the virus of the genus Aphtovirus belonging to the family Picornaviridae, it has an envelopeless icosahedric capsid and by a ribonucleic acid (RNA) molecule of approximately 8,400 nucleotides [16].

Among the seven serotypes of the virus (A, O, C, Asia-1, SAT1, SAT2 and SAT-3), serotypes A, O and C were isolated in occurrences in Brazil. However, several serotypes with different degrees of virulence are described, especially between serotypes A and O [17].

After infection, the incubation period can be from 02 to 21 days (average three to eight) and large amounts of viruses are excreted by infected animals even before clinical signs are evident. Infected animals exhibit blisters and ulcers in the mouth, tongue, lips, feet and udders. Clinically, animals salivate excessively, have fever and sore feet, lose weight and stop producing milk. The losses caused by the disease reflect the fall in productivity and

loss of markets, in addition to embargoes and sanitary barriers applied by meat importers, increase in public and private costs of prevention, control and eradication and compensation when necessary the sacrifice of animals. The losses are also due to the expenses of all the work necessary to return the status of disease-free area according to The OIErules [18].

Foot-and-mouth disease still occurs in large parts of the world. Its cross-border nature is becoming increasingly important due to the rapid development of international trade in animals and animal products and the increased movement of people around the world [19].

Foot-and-mouth disease is endemic in Africa, much of Asia, the Middle East and parts of South America (Fig. 2). Recently, clusters of foot-and-mouth disease viruses have been determined and seven virus pools have been identified (Fig. 3), where several serotypes occur, but within which there are topotypes that remain mostly confined to this pool. Three pools were defined covering Europe, the Middle East and Asia, three pools covering Africa and a pool covering the Americas. This classification allows a regional approach to be adopted to assist in the global control of foot-and-mouth disease (Fig. 4).

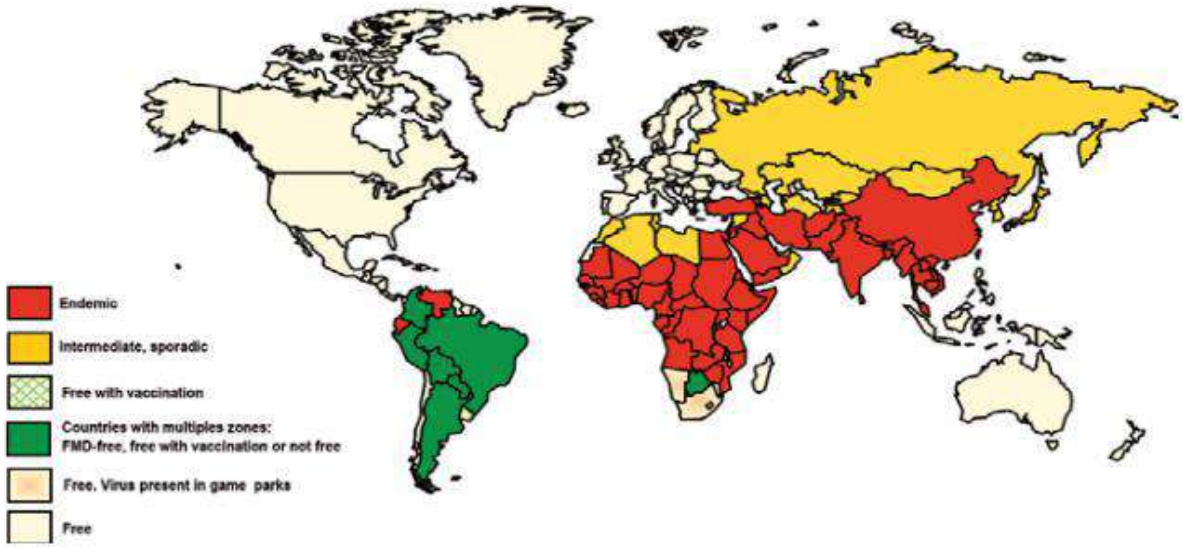

Fig. 2: The conjecture status of foot-and-mouth disease in the world (FAO/OIE, 2012).

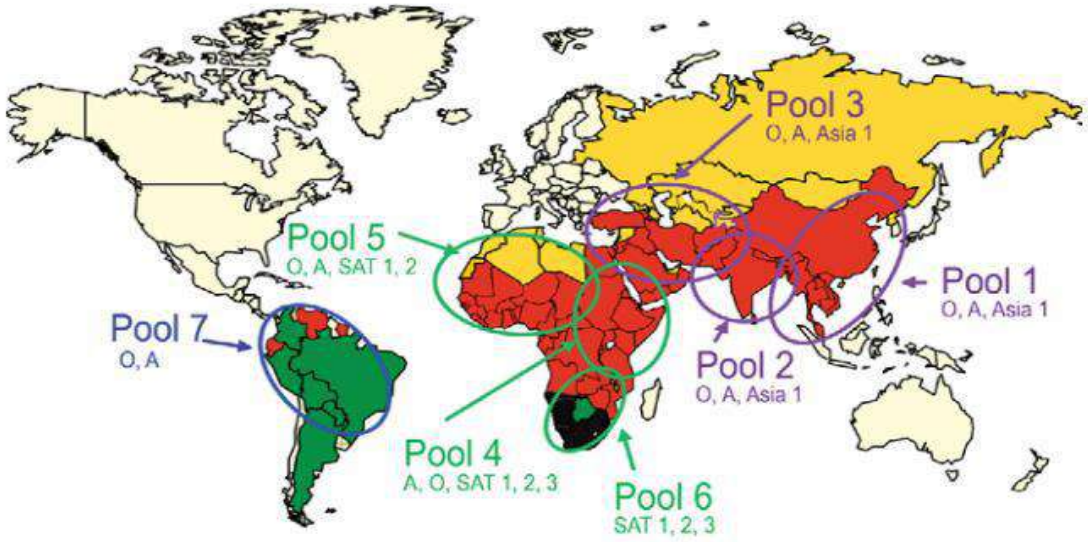

Fig. 3: The conjecture status of foot-and-mouth disease showing approximate distribution of regional virus pools. (FAO/OIE, 2012).

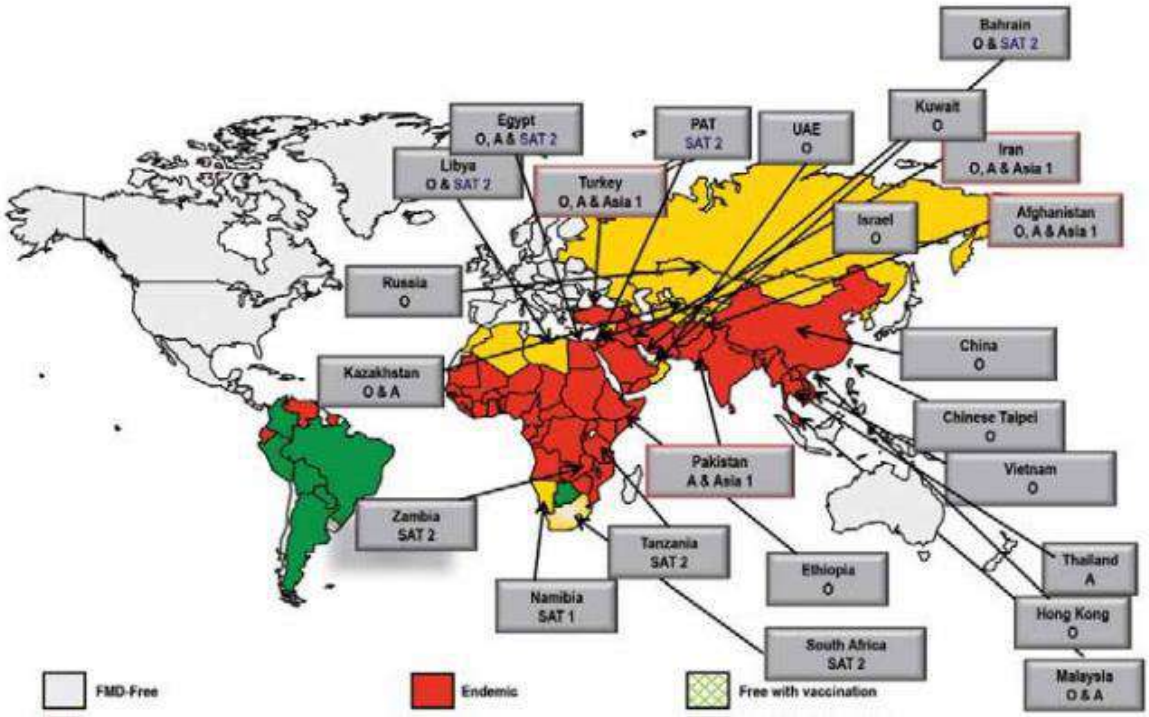

Fig. 4: Overall incidence of foot-and-mouth disease: serotypes identified in the first half of 2012 (FAO/OIE, 2012).

In Brazil, the occurrence of Foot-and-mouth disease was first recorded in 1895 after the description of the occurrence of the disease in Argentina and Uruguay, coinciding with the systematic importation of bovine breeders of European breeds in the emergence of the refrigeration industry[17].

Foot-and-mouth disease is the most significant animal disease and concern worldwide, due to its high infection and contagiousness among animals, bovine species, sheep, goats, swine and wild animals biungulates, causing economic damage throughout the production chain, especially in disabling meat exports, making the production chain unviable [20].

e) Wildlife x Foot-and-Mouth Disease

Studies involving epidemiological serum analyses for foot-and-mouth disease in wild animals are older studies or belonging to regions considered endemic, with frequent occurrence of foci.

Paes (2001) reports the scarcity of information about the problem of foot-and-mouth disease in the Pantanal of Mato Grosso do Sul in relation to viral circulation in wild animals and considers it important to control this disease[21].

In his master's thesis conducting a research of anti-virus antibodies of foot-and-mouth disease in susceptible and unvaccinated domestic and wild animal species, in the pantanal of Mato Grosso do Sul, Paes considers the possibility of, in the specific cases of baguás and bubalinos cattle with older age, the specificity and titer of the antibodies against foot-and-mouth disease virus found, has been the result of an episode of infection that occurred in a distant period at the time of the collection of sera samples from these animals; it may be hypothesis that older individuals have undergone more than one infection caused by different serotypes, and in these cases the stimulus of memory immune response. This explains the non-predominance of a more specific and distinct serological reactivity profile capable of identifying the type of virus that was circulating in the field at the time the samples were obtained in 1998[21].

Paes (2001) also indicates the possibility of infection caused by foot-and-mouth disease virus in domestic and wild bi-ungulate species, a fact attested by sera samples with the presence of antibodies against the VIA antigen now detected in the BFL-ELISA test, although the sampled animals do not present clinical symptoms of the disease and concludethat although the domestic and wild animals studied may be carriers of the same virus and be able to infect the other, there is no evidence in their study that one population predominates as the origin of infection for the other [21].

Taiassusides (cateto and cumptives) are ungulates susceptible to foot-and-mouth disease virus, but no cases

of the disease have been reported in Brazil[22]. In another study conducted at embrapa amazônia breeding, in order to identify the endoparasitosis and the most common parasitic flora in animals, they also collected caititu material and complained for serological diagnoses of zoonoses such as brucellosis, leptospirosis, tuberculosis and foot-and-mouth disease. The results were all negative or with low titration [23].

Some fauna animals, present in the State, play an important role in the dissemination of other diseases, especially in flooded regions with flooded temperatures. Vieira et. al (2013) reported that mammals from the pantanal of Nhecolândia (wild dog and quatis) presented a potential risk of dissemination of leptospirosis. The analyses indicate that these species were reagents indicating that the antigen is circulating in the environment and suggesting that they are participating in their transmission chain, due to the high density and way of life of these species; other species of wild rodents have also beentested [24].

Among wild animals, the only reservoir of foot-and-mouth disease virus is the African buffalo (Syncerus caffer), a wild animal that does not exist in Brazil. It is important to differentiate it from domestic buffalo (Bubalus bubalis), an animal used in Brazil for milk, meat and labor production. The African buffalo remains for up to five years as a carrier of the virus, and is the only animal species proven capable of transmitting foot-and-mouth disease virus as a carrier. In Brazil, there are no wild animals that play the role of reservoir, although there are several susceptible species, such as capybaras, tapirs, cervids and taiassuids, among others[3].

As demonstrated by Paes (2001), beef and buffalo cattle, which have not been vaccinated, keep the virus for a long period of time, as asymptomatic carrier, with the production of high serum levels of antibodies[21].

The control of wild boars is necessary for the health defense, because wild boar is a risk to crops and production animals, especially pigs from technical farms and subsistence, due to the possible transmission of diseases such as classical swine fever, African swine fever, reproductive and respiratory syndrome of pigs - PRRS, aujeszky disease, however, the boar, despite being an animal that is a suspectible foot-and-mouth disease, does not become a carrier. Semagro Resolution No. 657 of December 22, 2017 regulates the transport of wild boar carcasses slaughtered with authorization from IBAMA for the purpose of population control and monitoring of Classical Swine Fever. The Surveillance Plan of the National Program of Suid Sidae's Health, valid from August 1, 2021, provides for epidemiological surveillance in technical and non-technical commercial farms, in subsistence farms and provides for monitoring for foot-and-mouth disease in assavage pigs carried out by the management registered in the Official Service of each State.

Although unvaccinated and wild domestic animals, studied in the pantanal of Mato Grosso do Sul, have presented antibodies to foot-and-mouth disease virus, there is no evidence that one population predominates as the origin of the infection for the other. There is a need for a planned complementary study, aiming at viral isolation and/or the detection of genes or gene segments of VFA, from esophageal-pharyngeal mucus of baguás cattle, Indian buffalo and sheep from this and other sub-regions of the Pantanal sulmatogrossense [21].

In addition to the African buffalo (Syncerus caffer) in sub-Saharan Africa, wildlife does not play a significant role in maintaining foot-and-mouth disease [25].

The reasons for the increase in the frequency of outbreaks in Zambia and nearby regions are not fully known, but it is suspected to be a consequence of the failure of control measures in the 1990s. The epidemiology of foot-and-mouth disease in this region is aggravated by the presence of a natural reservoir such as African buffalo; the presence of six or seven foot-and-mouth disease serotypes, especially SAT; the mutation of foot-and-mouth disease virus; the high concentration of wildlife; the movement of commercial herds and the knowledge, attitude and perception of small producers about the disease [26].

To date, scientific evidence indicates that outside the situation of sub-Saharan Africa, with types of Foot-and-mouth disease SAT adapted to the African buffalo, effective control of foot-and-mouth disease among domestic herds will result in the protection of both livestock and wildlife, without the need for direct management or intervention activities directed to wildlife [25].Efforts to control the disease should be directed to vaccination, improved herd management practices, and use of disease control programs [25].

The aimof this study wastoincrease the risk of reintroduction of foot-and-mouth disease virus related to the coexistence of commercial herds in areas of high density of wild fauna.

II. MATERIALS AND METHODS

This is a systematic literature review that includes a descriptive phase of data selection relating scientific productions, master's dissertations, doctoral theses, books and electronic data that addressed the researched theme.

Pubmed was used as an electronic database, and Google Scholar: the strategies for searching for computerized data were foot and mouth disease Brazil, foot and mouth disease virus Brazil, foot-and-mouth disease Brazil, foot-and-mouth disease virus in Brazil, wild fauna, risk criteria, pantanal sul-matogrossense, wild animals, biungulates and primary source of infection - resulting in articles published between 1986 and 2021 and which also resulted in more research articles ("articles related" to the search result in Google Scholar - articles present in Science Direct).

Books related to the objective to be researched, electronic data from the website of the Ministry of Agriculture, Livestock and Supply-MAPA, Brazilian Association of Meat Exporting Industries, World Organization for Animal Health-OIE and the Brazilian Agricultural Research Company-EMBRAPA were used. It is important to report that the articles were selected by title, abstract and availability.

III. RESULTS AND DISCUSSION

All scientific papers selected for this publication were systematically analyzed. The works were separated by major themes such as geographic data from Mato Grosso do Sul, wild fauna and foot-and-mouth disease.

The geographic data and herd data from Mato Grosso do Sul used were the case reports and concepts used to establish climatic, vegetation and hydrography parameters, as well as statistical data from the last livestock census conducted in 2020.

Regarding the disease studied, foot-and-mouth disease, information on the etiology of the disease and epidemiological data published in various documents in various regions of the world were used. The difference in research methodologies was verified in endemic regions and regions that have some control of the commercial herd. In endemic areas, the studies are well detailed, with viral isolation and characterization of the serotype.

Considering the majority of the results of the studies conducted in the last 45 years, the object of this research, it was demonstrated that despite some commercial creations, especially those of extensive breeding and contact with free-living animals, it does not characterize imminent risk of introduction, dissemination and maintenance of foot-and-mouth disease virus. This situation may be related to the coexistence not always so close and constant of wild species and controlled herds.

It is clear in several results described that direct transmission occurs through contact between infected and susceptible animals by ingestion or inhalation of viral particles contained in secretions and excretions and transmission may also occur indirectly by animated and inanimate vectors as described by Souza (2007) [27]. In areas considered endemic, the movement of infected animals by means of transport between different regions is one of the forms of dissemination of the disease. In addition, the virus remains viable in the form of aerosols and can be distributed by airways between long distances if subjected to favorable heat and humidity conditions [28].

Due to the difficulty of capturing and manipulating wild animals, respecting the physiology of the animal and the well-being of the species, the official monitoring has the experimental design considering all controlled production units, classified by the production purpose and production system adopted.

The National Surveillance Program for Foot-and-Mouth Disease maintains monitoring for the disease on a regular basis in all units of the federation, thus ensuring the absence of viral circulation in the south-mato-grossense territory. The animals reagent in the initial phases of the investigation are submitted to material collection for the use of a test of greater specificity.

As in the surveys for Newcastle disease and avian influenza in migratory bird sites, resident birds, chickens raised extensively, with direct and indirect contact with migratory birds are used. Thus, due to the specificity and sensitivity of the methods of diagnosis of choice, it is possible to monitor a certain disease safely. In the case of birds, there are in some of the established sites, serological and molecular diagnosis is made wild birds, also making it possible to catalog the migrant species and estimate the amount.

IV. CONCLUSION

In the state of Mato Grosso do Sul, there has been no outbreak of foot-and-mouth disease for more than fifteen years. Despite being a very rich state in relation to fauna and flora, in the last three foci of foot-and-mouth disease there was no solution of continuity or there was no correlation with regard to the transmission of foot-and-mouth disease by wild animals. It is certain that there are margins for more scientific studies related to this theme, but what is concluded is that the risk of resident wildlife as the primary source of foot-and-mouth disease virus in the State of Mato Grosso do Sul, is considered almost nonexistent.

Believing that the conservation of environmental preservation areas and the socioeconomic development of the regions in Mato Grosso do Sul should coexist, especially in the Pantanal region, is that the need for

sanitary surveillance on properties and awareness to the producer is of paramount importance. Other actions such as: animal traffic control; sensitivity of producers to increase the notification of suspected occurrence of diseases or deaths; surveillance in agricultural events and surveillance in slaughter ings, the final link in the production chain.

It is important to highlight that the risk of foot-and-mouth disease contamination is composed of several factors such as: the efficiency of surveillance or health control in the country, supervision of animal transport, existence of veterinary service (public and private), coverage of vaccination campaigns, cooperation and awareness of the government and producers regarding the importance of maintaining the health status of foot-and-mouth disease free with and without vaccination.

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Boussinesq-type Equation Formulated using the Weighted Taylor Series

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***Keywords*— weighted Taylor series, the same control volume.**

***Abstract*—** *In this study, a Boussinesq equation was developed to model water waves. The equations were formulated using a weighted Taylor series, the Taylor series with weighted coefficients in the terms. The equation consists of the water surface elevation equation, the water particle velocity in the direction of the horizontal axis and vertical axis. The formulation of the continuity equation and the momentum equation is carried out on the same control volume with the same characteristics of particle velocity change. Thus, both equations have velocity variables with the same characteristics. The study obtained the Boussinesq equation that can be used with large wave amplitudes that are in line with those found in nature and can model shoaling and breaking well.*

I. INTRODUCTION

The time series water wave model is generally referred to as the Boussinesq equation. There are many versions of the Boussinesq equation, both the continuity equation or the water surface equation and the momentum equation. Among researchers who developed the Boussinesq equationareBoussinesq (1871), Dingermans(1997), Hamm, Madsen, and Peregrin(1993), Johnson (1997), Kirby (2003), Peregrine (1967), Peregrine (1972), and many more. These equations are formulated using continuity equation and Euler'sthe momentum equation, which are well known, but in different explanationsmaking each researcher has his own Boussinesq equation.

The Boussinesq equations in this study were formulated using a different method from the previous Boussinesq equation formulation. This study formulated the continuity equation and momentum equation using the weighted Taylor series (Hutahaean, 2021a). The total acceleration in the momentum equation is formulated using the same control volume as in the continuity equation, where the horizontal velocity of x-direction only changes on the x-direction and the vertical velocity of z-direction changes only on the z-axis of vertical.

The basic form of the continuity equation obtained is the sum of the total acceleration in the horizontal-$x$direction with the total acceleration in the vertical z-axis. Furthermore, by working on very small time intervals, the term acceleration versus time (localacceleration) is omitted, obtaining a continuity equation in the form of a spatial differential only, as is the case with the continuity equation that has been widely used. However, there is a weighting coefficient on the horizontal differential term.

Furthermore, by reducing the spatial size of the control volume in the horizontal x-direction and in the vertical-$z$direction, the relation between the local acceleration of the particle in the vertical z-axis and the local acceleration of the particle in the horizontal x-direction is obtained. This relation is used to calculate the particle velocity in the vertical z-direction. While the particle velocity equation in the horizontal x-directionis obtained from the momentum equation in the horizontal x-direction. The hydrodynamic pressure and dynamic driving force in the horizontal axis-$x$are obtained by integrating the vertical z-direction momentum equation on the vertical axis.

By using the same control volume in the formulation of the continuity equation with the formulation of the momentum

equation, the definitive equation equal to the velocity of the particlewas obtained. Hence, there is a harmony between the continuity equation and the momentum equation.

Continuity Equation Formulation

The continuity equation is formulated by working on the principle of conservation of mass in an incompressible flow using the control volume in Figure (1). The input-output due to fluid flow in the control volume is as follows.

Input,

$I = \rho u\, \delta z + \rho w\, \delta x$

Output,

$O = \rho(u + \delta u)\delta z + \rho(w + \delta w)\delta x$

As a result of the input and output, at the small time interval δt, there is a change in the fluid mass at the control volume of,

$\delta m = (I - O)\delta t$

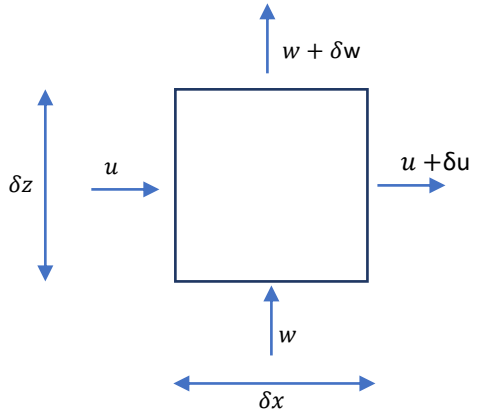

Fig.1: Input-output on the controlvolume

Substitute the input and output equations, and divide both sides of the equation by$\delta t\, \delta x\, \delta z$,

$$\frac{\delta m}{\delta t \delta x\, \delta z} = -\rho \frac{\delta u}{\delta x} - \rho \frac{\delta w}{\delta z}$$

For a constant control volume, the mass change in the control volume is

$\delta m = \delta \rho\, \delta x\, \delta z$

equation obtained:

$$\frac{\delta \rho}{\delta t} = -\rho \frac{\delta u}{\delta x} - \rho \frac{\delta w}{\delta z}$$

for incompressible flow$\frac{\delta \rho}{\delta t} = 0$,

$$\frac{\delta u}{\delta x} + \frac{\delta w}{\delta z} = 0 \quad \ldots\ldots(1)$$

Equation (1) is a continuity equation in a very basic form. The derivative form of (1) is determined by the definitions of δu and δw. To get the form of δu and δw, the weighted Taylor series (Hutahaean, 2021a) is used for a function:

$$f(x, z, t) = \cosh k(h + z) \cos kx \cos \sigma t$$

k is the wave number, h is the water depth, σ is the angular frequency, x is the horizontal axis, z is the vertical axis, and t is the time. This equation is a form of velocity potential solution to Laplace's equation (Dean, 1991).$\cos \sigma t$ is used instead of $\sin \sigma t$. The weighted Taylor series from the equation is:

$$f(x + \delta x, z + \delta z, t + \delta t) = f(x, z, t)$$
$$+\gamma^2\, \delta t \frac{\partial f}{\partial t} + \gamma\, \delta x \frac{\partial f}{\partial x} + \delta z \frac{\partial f}{\partial z}$$

..(2)

$\gamma$is the weighting coefficient. In (2), there is a relation,

$\delta z = \gamma\, \delta x$ ……(3)

For the horizontal velocity$u(x, z, t)$, the only thing that change is the horizontal x-direction,

$$u(x + \delta x, z, t + \delta t) = u(x, z, t)$$
$$+\gamma^2\, \delta t \frac{\partial u}{\partial t} + \gamma\, \delta x \frac{\partial u}{\partial x}$$

The first term of right-hand side is moved to the left and defined,

$\delta u = \gamma^2 \delta t \frac{\partial u}{\partial t} + \gamma\, \delta x \frac{\partial u}{\partial x}$…..(4)

For the vertical velocity $w(x, z, t)$, which changes in the vertical z-direction only,

$$w(x, z + \delta z, t + \delta t) = w(x, z, t)$$
$$+\gamma^2\, \delta t \frac{\partial w}{\partial t} + \delta z \frac{\partial w}{\partial z}$$

δw is

$\delta w = \gamma^2\, \delta t \frac{\partial w}{\partial t} + \delta z \frac{\partial w}{\partial z}$….(5)

Substitute (4) and (5) to (1),

$$\frac{\gamma^2\, \delta t \frac{\partial u}{\partial t} + \gamma\, \delta x \frac{\partial u}{\partial x}}{\delta x} + \frac{\gamma^2\, \delta t \frac{\partial w}{\partial t} + \delta z \frac{\partial w}{\partial z}}{\delta z} = 0$$

Substitute$\delta z$by (3)in the denominator of the second term and multiplying the equation by$\gamma\, \delta x$,

$$\gamma^3 \delta t \frac{\partial u}{\partial t} + \gamma^2\, \delta x \frac{\partial u}{\partial x} + \gamma^2\, \delta t \frac{\partial w}{\partial t} + \delta z \frac{\partial w}{\partial z} = 0$$

…(6)

Then, with constantδxandδz, $\delta t$is reduced to close to zero, the equation becomes,

$$\gamma^2\,\delta x\,\frac{\partial u}{\partial x}+\,\delta z\,\frac{\partial w}{\partial z}=0$$

Substitute$\delta z$by (3)and divide the equation by $\gamma\,\delta x$,

$$\gamma\,\frac{\partial u}{\partial x}+\frac{\partial w}{\partial z}=0\ldots.(7)$$

(7) is theweighted continuity equationthat will be used to formulate the water surface elevation equation, in the following section.

II. THE FORMULATION OF WATER SURFACE EQUATION$\eta(x,t)$.

The continuity equation (7) is multiplied by $dz$and integrated over water depth,

$$\gamma\int_{-h}^{\eta}\frac{\partial u}{\partial x}dz+\int_{-h}^{\eta}dw=0$$

The integration of the 1st term is accomplished by the Leibniz integration rule. The equation of the Leibniz integral rule (Protter, Murray, Morrey, &Charles, 1985)is:

$$\int_{\alpha}^{\beta}\frac{\partial f}{\partial x}dz=\frac{\partial}{\partial x}\int_{\alpha}^{\beta}u\,dz-\,f_{\beta}\frac{\partial \beta}{\partial x}+f_{\alpha}\frac{\partial \alpha}{\partial x}\ldots\ldots(8)$$

Then the integration of the 1st term is,

$$\gamma\int_{-h}^{\eta}\frac{\partial u}{\partial x}dz=\gamma\frac{\partial}{\partial x}\int_{-h}^{\eta}u\,dz-\,\gamma u_{\eta}\frac{\partial \eta}{\partial x}-\gamma u_{-h}\frac{\partial h}{\partial x}$$

where$\frac{\partial(-h)}{\partial x}=-\frac{\partial h}{\partial x}$, $u_{\eta}$is the horizontal velocity at the surface, while$u_{-h}$is the horizontal velocity on the sea bed. This integration is substituted into(8), whilew_{η}particle velocity of z-direction is substituted by weighted Kinematic Free Surface Boundary Condition (Hutahaean, 2021a), which is:

$$w_{\eta}=\gamma\frac{\partial \eta}{\partial t}+u_{\eta}\frac{\partial \eta}{\partial x},$$

So,

$$\gamma\frac{\partial}{\partial x}\int_{-h}^{\eta}udz-\,\gamma u_{\eta}\frac{\partial \eta}{\partial x}-\gamma u_{-h}\frac{\partial h}{\partial x}$$
$$+\gamma\frac{\partial \eta}{\partial t}+u_{\eta}\frac{\partial \eta}{\partial x}-w_{-h}=0$$

Integration is completed by working on the concept of depth average velocity, while $w_{-h}$is substituted with the bottom kinematic boundary condition,

$$\gamma\frac{\partial \eta}{\partial t}+\gamma\frac{\partial \beta_u UH}{\partial x}+(1-\gamma)\alpha_{u\eta}U\frac{\partial \eta}{\partial x}+(1-\gamma)\alpha_{uh}U\frac{\partial h}{\partial x}=0$$

…(9)

$U$is the horizontal depth average velocity, $\beta_u$is the coefficient integration, $H$is the total water depth $H=h+\eta$, while$\alpha_{u\eta}$is the transformation coefficient from the horizontal surface velocity$u_{\eta}$to the depth average velocity U, while$\alpha_{uh}$is the transformation coefficient from$u_{-h}$to depth average velocity U.These coefficients will be discussed in section 4.

III. EQUATION OF PARTICLE VELOCITY IN THE HORIZONTAL DIRECTION AND VERTICAL DIRECTION

3.1. Momentum equation

For the conformity with the continuity equation, the momentum equation will be formulated using the control volume in figure (1) where the horizontal velocity u only changes on the horizontal x-axis, while the vertical velocity w only changes on the vertical z-axis. Equation (4) is divided by δt and very small δt and δxclose to zero were taken,

$$\frac{Du}{dt}=\gamma^2\frac{\partial u}{\partial t}+\gamma\,u\frac{\partial u}{\partial x}\quad\ldots\ldots(10)$$

This equation is the total acceleration in the horizontal x-direction. Equation (5) is divided by δt and very small δtandδzclose to zero were taken,

$$\frac{Dw}{Dt}=\gamma^2\frac{\partial w}{\partial t}+w\frac{\partial w}{\partial z}\quad\ldots\ldots(11)$$

This equation is the total acceleration in the vertical z-direction.

A method is used to formulate the Euler's momentum equationin (10) and (11),that the mass multiplied by the acceleration is the same as the driving force, the equations for the horizontal x-directionand vertical z-direction are obtained, respectively,

$$\gamma^2\frac{\partial u}{\partial t}+\gamma\,u\frac{\partial u}{\partial x}=-\frac{1}{\rho}\frac{\partial p}{\partial x}\quad\ldots\ldots.(12)$$
$$\gamma^2\frac{\partial w}{\partial t}+w\frac{\partial w}{\partial z}=-\frac{1}{\rho}\frac{\partial p}{\partial z}-g\ldots\ldots.(13)$$

3.2. Hydrodynamic Pressure Equation

To obtain the pressure equation$p$, (13) is multiplied by $dz$and integrated about the vertical z-axis,

$$\gamma^2\int_z^{\eta}\frac{\partial w}{\partial t}\,dz+\frac{1}{2}\int_z^{\eta}dww=-\frac{1}{\rho}\int_z^{\eta}dp-g\int_z^{\eta}dz$$

The integration of the 2ndterm on the left and the 1st and 2nd terms on the right is solved.The surface dynamic boundary conditions are done$p_{\eta}=0$and the equation is written as the equation for p,

$$\frac{p}{\rho}=\gamma^2\int_z^{\eta}\frac{\partial w}{\partial t}\,dz+\frac{1}{2}\left(w_{\eta}w_{\eta}-ww\right)+g(\eta-z)$$
…..(14)

This equation is the hydrodynamic pressure equation. Next, (14) is differentiated about the horizontal x-axis,

$$\frac{1}{\rho}\frac{\partial p}{\partial x}=\gamma^2\frac{\partial}{\partial x}\int_z^{\eta}\frac{\partial w}{\partial t}\,dz+\frac{1}{2}\frac{\partial w_{\eta}w_{\eta}}{\partial x}-\frac{1}{2}\frac{\partial ww}{\partial x}+g\frac{\partial \eta}{\partial x}$$

Hutahaean (2021b) solves the integration and differential on the 1st term on the right side of the equation by using the velocity potential of the solution to the Laplace equation obtaining

$$\frac{1}{\rho}\frac{\partial p}{\partial x} = \gamma^2\left(\frac{\partial u_\eta}{\partial t} - \frac{\partial u}{\partial t}\right) + \frac{1}{2}\frac{\partial w_\eta w_\eta}{\partial x} - \frac{1}{2}\frac{\partial ww}{\partial x} + g\frac{\partial \eta}{\partial x}$$

……..(15)

This equation is the equation for the hydrodynamic driving force in the horizontal x-direction.

3.3. Velocity Equation in the Horizontal x-direction

(15) is substituted to (12),

$$\gamma^2\frac{\partial u}{\partial t} + \frac{\gamma}{2}\frac{\partial uu}{\partial x} = -\gamma^2\left(\frac{\partial u_\eta}{\partial t} - \frac{\partial u}{\partial t}\right) - \frac{1}{2}\frac{\partial w_\eta w_\eta}{\partial x} + \frac{1}{2}\frac{\partial ww}{\partial x} - g\frac{\partial \eta}{\partial x}$$

The 1st term on the left side and the the 2nd term on the right side cancel each other out, then this equation is multiplied by dz and integrated over water depth,

$$\gamma^2\frac{\partial u_\eta}{\partial t}H + \frac{\gamma}{2}\int_{-h}^{\eta}\frac{\partial uu}{\partial x}dz = -\frac{1}{2}\frac{\partial w_\eta w_\eta}{\partial x}H + \frac{1}{2}\int_{-h}^{\eta}\frac{\partial ww}{\partial x}dz - g\frac{\partial \eta}{\partial x}H \text{ …….(16)}$$

The integration of the 2nd term on the left and right sides is solved by the Leibniz Integral rule,

$$\int_{-h}^{\eta}\frac{\partial uu}{\partial x}dz = \frac{\partial}{\partial x}\int_{-h}^{\eta}uu\,dz - u_\eta u_\eta\frac{\partial \eta}{\partial x} - u_{-h}u_{-h}\frac{\partial h}{\partial x}$$

The integration of the right-hand side is solved by using the concept of depth average velocity,

$$\int_{-h}^{\eta}\frac{\partial uu}{\partial x}dz = \frac{\partial \beta_{uu}UUH}{\partial x} - u_\eta u_\eta\frac{\partial \eta}{\partial x} - u_{-h}u_{-h}\frac{\partial h}{\partial x}$$

β_{uu} is the coefficient integration, that will be discussed in section 4, then the horizontal velocity at the surface u_η and the horizontal velocity on the sea bed u_{-h} are transformed into horizontal depth average velocity,

$$\int_{-h}^{\eta}\frac{\partial uu}{\partial x}\,dz = \frac{\partial \beta_{uu}UUH}{\partial x} - \alpha_{u\eta}\alpha_{u\eta}UU\frac{\partial \eta}{\partial x} - \alpha_{uh}\alpha_{uh}UU\frac{\partial h}{\partial x}$$

$\alpha_{u\eta}$ and α_{uh} are transformation coefficients that will be discussed in section 4.

In the same way, it will be obtained,

$$\int_{-h}^{\eta}\frac{\partial ww}{\partial x}dz = \frac{\partial \beta_{ww}WWH}{\partial x} - \alpha_{w\eta}\alpha_{w\eta}WW\frac{\partial \eta}{\partial x} - w_{-h}w_{-h}\frac{\partial h}{\partial x}$$

β_{ww} coefficient integration and $\alpha_{w\eta}$ is the transformation coefficient. Kinematic sea bed boundary condition is $w_{-h} = -u_{-h}\frac{\partial h}{\partial x}$. So

$$w_{-h}w_{-h}\frac{\partial h}{\partial x} = -u_{-h}u_{-h}\left(\frac{\partial h}{\partial x}\right)^3$$

$\frac{\partial h}{\partial x}$ is the small bottom slope, so $w_{-h}w_{-h}\frac{\partial h}{\partial x}$ is very small and can be ignored, so

u_η in (16) is transformed into U and w_η is transformed into W and divided by H,

$$\gamma^2\alpha_{u\eta}\frac{\partial U}{\partial t} + \frac{\gamma}{2H}\int_{-h}^{\eta}\frac{\partial uu}{\partial x}dz = -\frac{\alpha_{w\eta}\alpha_{w\eta}}{2}\frac{\partial WW}{\partial x} + \frac{1}{2H}\int_{-h}^{\eta}\frac{\partial ww}{\partial x}dz - g\frac{\partial \eta}{\partial x}$$

The result of integration is substituted $\int_{-h}^{\eta}\frac{\partial uu}{\partial x}dz$ and $\int_{-h}^{\eta}\frac{\partial ww}{\partial x}dz$

$$\gamma^2\alpha_{u\eta}\frac{\partial U}{\partial t} + \frac{\gamma}{2H}\frac{\partial \beta_{uu}UUH}{\partial x} - \frac{\gamma\alpha_{u\eta}\alpha_{u\eta}}{2H}UU\frac{\partial \eta}{\partial x} - \frac{\gamma\alpha_{uh}\alpha_{uh}}{2H}UU\frac{\partial h}{\partial x} = -\frac{\alpha_{w\eta}\alpha_{w\eta}}{2}\frac{\partial WW}{\partial x} + \frac{1}{2H}\frac{\partial \beta_{ww}WWH}{\partial x} - \frac{\alpha_{w\eta}\alpha_{w\eta}}{2H}WW\frac{\partial \eta}{\partial x} - g\frac{\partial \eta}{\partial x}\text{…..(17)}$$

(17) is the equation for the particle velocity in the horizontal x-direction.

3.4. Velocity Equation vertical z-direction

In (6), with constant δt, the size of δx and δz are reduced to a point, so that the 2nd and 4th terms become zero, then divided by $\gamma^2\,\delta t$, then the equation becomes,

$$\gamma\frac{\partial u}{\partial t} + \frac{\partial w}{\partial t} = 0$$

This equation is written as the equation for $\frac{\partial w}{\partial t}$ multiplied by dz and integrated about the vertical z-direction. The integration is completed by Leibniz integral rule and the concept of depth average velocity is obtaining

$$\beta_w H\frac{\partial W}{\partial t} + (\beta_w - \alpha_{w\eta})W\frac{\partial \eta}{\partial t} = -\gamma\beta_u H\frac{\partial U}{\partial t} + \gamma(\beta_u - \alpha_{u\eta})U\frac{\partial \eta}{\partial t} \quad \text{……(18)}$$

In this equation $\frac{\partial U}{\partial t}$is obtained from (17) while$\frac{\partial \eta}{\partial t}$is obtained from (9). The equation(18) can be said to be an expression of the law of conservation of energy, where there is an interaction of $\frac{\partial U}{\partial t}$, $\frac{\partial W}{\partial t}and\frac{\partial \eta}{\partial t}$.

IV. COEFFICIENT INTEGRATION AND TRANSFORMATION COEFFICIENT

In the previous sections, the integration of water depth is done using the concept of depth average velocity, where the depth average velocity (Dean, 1991) is,

$$U(x,t) = \frac{1}{\beta_u H}\int_{-h}^{\eta} u\, dz \quad \ldots\ldots(19)$$

β_u =Coefficient of integration of horizontal velocity u, and$H = h + \eta$

Furthermore, in this study, it is defined that the depth average velocity is the velocity at a depth of $z = z_0$ (Fig. 2), and the integration coefficient β_u is,

$$\beta_u = \frac{1}{Hu(x,z_0,t)}\int_{-h}^{\eta} u\, dz$$

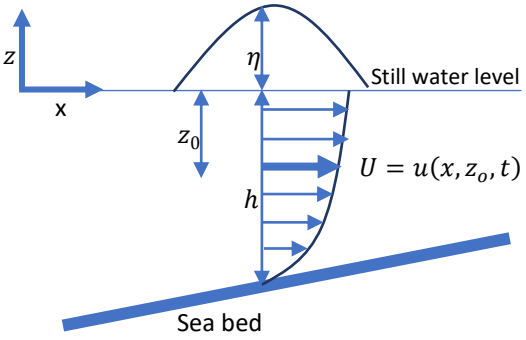

Fig 2. Depth average velocity

Using the particle velocity equation from the velocity potential,

$$u(x,z,t) = Gk\cosh k(h+z)\cos kx \sin \sigma t$$

So,

$$\frac{u}{U} = \frac{\cosh k(h+z)}{\cosh k(h+z_0)}$$

$$\beta_u = \frac{1}{H\cosh k(h+z_0)}\int_{-h}^{\eta}\cosh k(h+z)\, dz$$

Integration is completed and by taking$\eta = \frac{A}{2}$, so

$$\beta_u = \frac{\sinh k\left(h+\frac{A}{2}\right)}{kH\cosh k(h+z_0)} \ldots..(20)$$

Law of conservation of wave number (Hutahaean. 2021),

$$\frac{\partial k\left(h+\frac{A}{2}\right)}{\partial x} = 0 \ldots..(21)$$

where$k\left(h+\frac{A}{2}\right) = kH = constant = \theta\pi$, so

$$\beta_u = \frac{\sinh \theta\pi}{\theta\pi\cosh k(h+z_0)} \ldots..(22)$$

So to get $\beta_u$is to set the value of$z_0$beforehand.

$\theta$is referred to as the deep water coefficient which is greater than or equal to 1 where $\tanh \theta\pi \approx 1$. This coefficient for defining the deep water limit, for exampleSPM (1984), using$\theta = 1$, in this case, deep water depth is$h_0 = \frac{L_0}{2}$. In this study,$\theta = 1.8$ is used, this value was obtained based on a study of the solution generated by the model.

$$\int_{-h}^{\eta} w\, dz = \beta_w WH$$

$$\beta_w = \frac{1}{H\sinh k(h+z_0)}\int_{-h}^{\eta}\sinh k(h+z)\, dz$$

By completing the integration obtaining,

$$\beta_w = \frac{\cosh \theta\pi - 1}{\theta\pi\sinh k(h+z_0)} \ldots.(23)$$

The other integration coefficients are,

$$\int_{-h}^{\eta} UU\, dz = \beta_{uu} UUH$$

$$\beta_{uu} = \frac{1}{H\cosh^2 k(h+z_0)}\int_{-h}^{\eta}\cosh^2 k(h+z)\, dz$$

By completing the integration obtaining,

$$\beta_{uu} = \frac{\left(\frac{1}{2}\sinh 2\theta\pi + \theta\pi\right)}{2\,\theta\pi\cosh^2 k(h+z_0)} \ldots.(24)$$

$$\int_{-h}^{\eta} WW\, dz = \beta_{ww} WWH$$

$$\beta_{ww} = \frac{1}{H\sinh^2 k(h+z_0)}\int_{-h}^{\eta}\sinh^2 k(h+z)\, dz$$

By completing the integration obtaining,

$$\beta_{ww} = \frac{\frac{1}{2}\sinh 2\theta\pi - \theta\pi}{2\theta\pi\sinh^2 k(h+z_0)} \ldots.(25)$$

The integration coefficients are calculated in deep water. The value of the integration coefficient is constant, considering (21).

In the momentum equation and the continuity equation, there are surface velocities $u_\eta$andw_η and seabed velocities u_{-h}andw_{-h}. These variables must be transformed into depth average velocity of U and$W$, with the following transformation coefficients.

$$u_\eta = \frac{\cosh \theta\pi}{\cosh k(h+z_0)}\, U$$

$$u_\eta = \alpha_{u\eta}\, U$$

$$\alpha_{u\eta} = \frac{\cosh \theta\pi}{\cosh k(h+z_0)} \ldots (26)$$

$$u_{-h} = \alpha_{uh}\, U$$

$$\alpha_{uh} = \frac{1}{\cosh k(h+z_0)} \ldots (27)$$

$$w_\eta = \alpha_w\, W$$

$$\alpha_{w\eta} = \frac{\sinh \theta\pi}{\sinh k(h+z_0)} \ldots (28)$$

The vertical velocity transformation on the sea bed cannot be used for potential flow equations because it will produce a vertical bottom velocity which is equal to zero. For this reason, the vertical bottomvelocity is changed to horizontal bottom velocity by using the kinematic bottom boundary condition, which is,

$$w_{-h} = -u_{-h}\frac{dh}{dx}$$

$\frac{dh}{dx}$is bottom slope, so

$$w_{-h} = -\alpha_{uh} U \frac{dh}{dx} \ldots (29)$$

V. MODEL RESULTS

First, the model is carried out on a channel with a constant depth, with a water depth of $h = 15.0\,m$ and a canal length of 300 m. The input is a sinusoidal wave with period $T = 8$ second and wave amplitude $A = 1.20\,m$. The calculation constants used are $\gamma = 1.6$, $\theta = 1.8$, and $z_0 = -0.4\,h$. The model is executed up to 11 times the wave period. The model outputs are presented in Figure 3 and Figure 4.

In the output of the model, the resulting solution is stable at the execution of 11 times the wave period. This shows the stability of the equation and the numerical method. The wavelength of the model is quite short, around 25 m (Figure 3 and Figure 4). The particle velocity in the vertical direction W is greater than the particle velocity in the horizontal direction U with the opposite phase. The horizontal phase velocity U is the same as the water surface movement phase η while the particle phase velocity in the vertical W-direction is opposite to both. This shows that the change in kinetic energy in the vertical direction is proportional to the amount of change in horizontal kinetic energy with changes in potential energy at the water surfaceelevation.

In addition, when $U = 0$ and $\eta = 0$, W is also equal to zero. This makes it easier to define the initial condition where at$t = 0$, $U = \eta = W = 0$.Calculation of the water particlevelocity in the vertical direction using the Kinematic Free surface Boundary Condition, there will be difficulties in defining the initial value, considering that this equation produces a phase where at $U = 0$and$\eta = 0$, the particle velocity in the vertical W-direction is in the maximum phase.

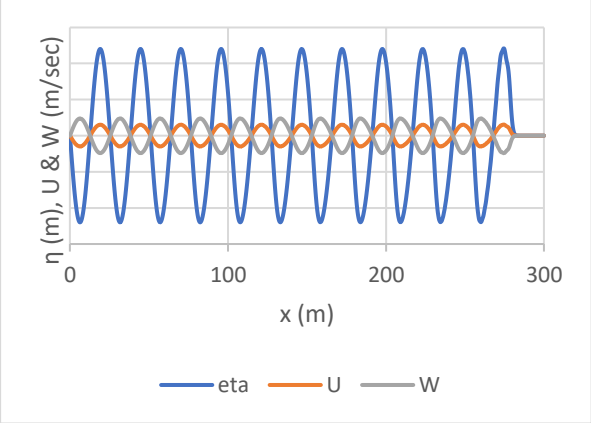

Fig 3. Output model on theflat bottom.

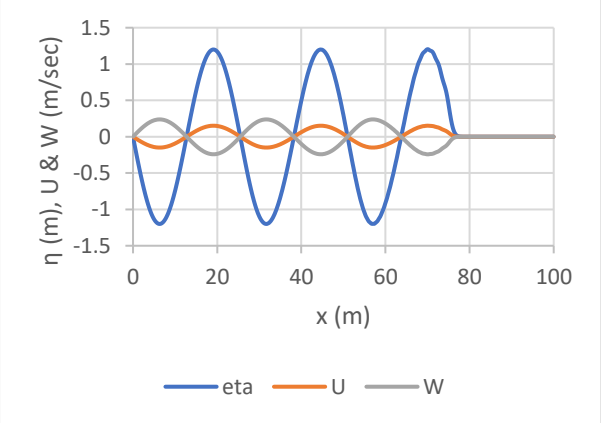

Fig 4. Output model on theflat bottom.

Next, the model is executed on a channel with a bottom slope of -0.07. The upstream water depth is 15.0 m, while the downstream water depth is 1.0 m, with a channel length of 200 m. The incoming wave is a sinusoidal wave with a wave period of $T = 8\,sec$, with an initial wave amplitude of $A_0 = 1.2\,m$. The model output is presented in Fig 5.

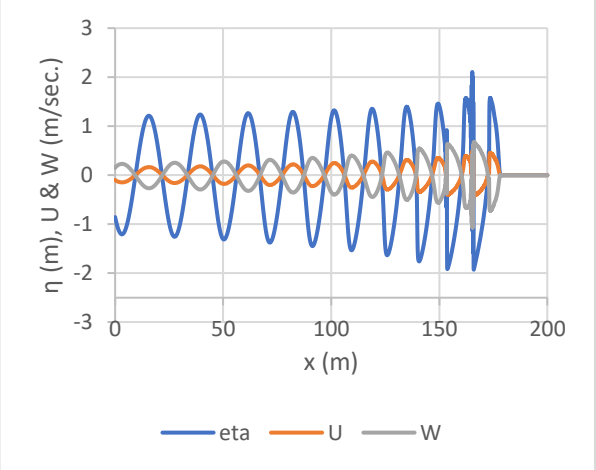

Fig 5. Output model on the sloping bottom.

Fig 5 shows that the model can model the phenomenon of shoaling well. At a distance of $x = 150.0\,m$, at a water depth of $h = 4.50\,m$, the wave begins to break, followed by the main breaking at $h = 3.80\,m$ with a breaking amplitude of $A_b = 1.5$. Furthermore, after breaking, the model stops after one wave period. From these results, it can be said that the model can simulate shoaling with breaking even though it is not complete until the waves disappear.

VI. CONCLUSION

The formulation of the total acceleration equation in the momentum equation using the same control volume as in the continuity equation provides certainty that the velocity characteristics in the momentum equation and the continuity equation are the same. Thus, it can be said that the velocity stated in the continuity equation is exactly the generated velocity by the momentum equation creating a good couple between the continuity equation and the momentum equation.

By defining that the depth average velocity is a representative velocity of the velocity at a certain depth, the integration coefficient, and the transformation coefficient can be calculated using the velocity potential theory.

The weighted coefficient on the Taylor series functions to adjust the particlewavelength and velocity, be it horizontal or vertical. The greater the value of the weighted coefficient, the shorter the wavelength, the smaller the particle velocity in the horizontal direction while the particle velocity in the vertical direction will be greater.

Determination of the deepwater depth represented by the deepwater coefficient, in addition to determining the stability of the solution, also determines the depth at which breaking begins to occur.

In general, the model gives good results where the model can be carried out at large wave amplitude that match those in nature, and the model can simulate shoaling and breaking well. However, it requires development so that the model can simulate breaking completely with the wave height that gradually gets smaller until it disappears after breaking.

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Classification of Cynodon spp. grass cultivars by UAV

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Abstract *— Traditional methods for estimating biomass in pasture frequently use destructive methods with high demand for time, resources and labor. The development of models for automated estimation of biomass and leaf area index, particularly from images captured by Unmanned Aerial Vehicle (UAV), saves resources and helps the adoption of anticipatory measures in the management of the experimental area. The objective of this study was to create a technical feasibility study for the use of UAV in the estimation of biomass, forage canopy height, and general conditions of Cynodon grass in plots, using volume and vigor by the radiometric and morphometric approach, the NDRE index, and digital terrain (DTMs) and digital surface (DSMs) models compared to scores by the specialist in the field. Visible (RGB), red edge (RedEdge) and near infrared (NIR) imaging cameras were used for continuous monitoring of the experimental area, of approximately 3,800 m², located at the José Henrique Bruschi Experimental Field (CEJHB), in the municipality of Colonel Pacheco, Minas Gerais, Brazil. After UAV imaging, we selected nine Cynodon spp. clones that showed greater vigor based on the data from the field plots and data obtained by UAV and classified using the method to estimate the vegetation vigor index (VVI) and classified by natural breaks in GIS.*

I. INTRODUCTION

Traditional methods for evaluating plants in the field aiming at genetic improvement, attribution of vigor scores and estimation of biomass frequently use destructive methods with high demand for time, resources and labor. In addition, these laborious procedures in the field can cause accuracy errors and not allow for a global assessment of the experimental area regarding phytosanitary issues, pests and diseases, as well as early mineral nutrient deficiencies.

The emerging and evolving technology in aerial photogrammetry survey with unmanned aerial vehicles (UAV) provides countless applications in infrastructure, transport and agricultural research on a daily basis. The ease, speed and versatility in acquiring data, images and metrics about targets on the Earth's surface allow highly efficient routine and interpretation activities in the field. The small UAV with cameras and multispectral sensors are now added to the new technologies in remote sensing and geoprocessing. These devices facilitate aerial surveys in the detection of biophysical variations in the field with frequency defined by the user and according to the phenological cycle, enabling monitoring of stresses linked to the water condition or pest infestation, in the herbaceous, shrubby or arboreal strata [1, 2, 3, 4].

Genetic selection, phenotyping, and the measurement of agronomic parameters in forages were previously carried out with multiple equipment and demanded a permanent team in the field. This work can now be done with orthophotos by cameras equipped with optical sensors, using scheduled UAV flights, without removing

forage for biomass estimates, for example, even under stress conditions [5, 6, 7]. However, this task must be carried out with safety and statistical significance, hence, several experimental surveys and tests must be performed to ensure that the UAV photogrammetric remote sensing data can support or even replace the cutting of forage clones and laboratory and field measurements.

The analyses and field tests with the UAV flights are based on surveys of geodetic GPS control points, with high accuracy and definition of transformations in the GIS (Geographic Information System) for estimates in the plots of *Cynodon* spp. grass.

Vegetation indices play an important role in pointing out forage stress phenomena [8, 9, 10, 11]. These trials used the vegetation indices described by the equations below:

$$NDVI = \frac{\rho_{nir} - \rho_{red}}{\rho_{nir} + \rho_{red}} \quad \text{(Eq. 1)}$$

$$VARI = \frac{\rho_{Green} - \rho_{Red}}{\rho_{Green} + \rho_{Red} - \rho_{Blue}} \quad \text{(Eq. 2)}$$

$$GLI = \frac{\left(2\,\rho_{Green} - \rho_{Red} - \rho_{Blue}\right)}{\left(2\,\rho_{Green} + \rho_{Red} + \rho_{Blue}\right)} \quad \text{(Eq. 3)}$$

$$CIgreen = \left(\frac{\rho_{nir}}{\rho_{green}}\right) - 1 \quad \text{(Eq. 4)}$$

$$NDRE = \frac{\rho_{nir} - \rho_{rededge}}{\rho_{nir} + \rho_{rededge}} \quad \text{(Eq. 5)}$$

Where ρ_{Green}, ρ_{Red}, ρ_{Blue}, $\rho_{rededge}$ and ρ_{nir} are the spectral bands referring to the channels of the green, red, blue, red edge and near-infrared (NIR), respectively.

The indices NDVI (Normalized Difference Vegetation Index) [8], VARI (Visible Atmospherically Resistant) [9], GLI (Green Leaf Index) [10], CIgreen (Green Clorophyl Index) and NDRE (Normalized Difference Red Edge) [11] were used to obtain maps that indicate the stresses relevant to phytosanitary problems, mineral deficiency, pest infestations, among others, in several experimental treatments applied to clones of *Cynodon* spp. from the Embrapa's genetic improvement program.

Image overlay and altimetric information, digital terrain (DTMs) and digital surface (DSMs) models are produced using stereoscopy, and thus it is possible to obtain altimetric and volumetric information and to determine the volume of plant biomass. Combined information on vegetation indices and forage volume gave rise to a multicriteria and method approach to estimate the forage vigor, taking radiometry and morphometry/volumetry into account, in order to unite the spectral response with the height or volume of the plants.

From the data on forage mass volume (m^3) in combination with the vegetation indices, it is possible to estimate a vigor measure by the sum of the anomalies of values around the mean, which are standardized by the deviation standard, in order to rank the experimental forage plots, in the face of the scores visually assigned in the field. The selection of the vegetation index involves observing the contrast in the histogram and the ability or numerical precision to distinguish existing variations in the vegetation. The VARI index was developed to take into account the reduction of possible influences of atmospheric constituents by subtracting the spectral band referring to the blue channel in the denominator of Equation 1. The GLI index (Equation 2) has been used to distinguish between photosynthetically active vegetation and dry vegetation with soil exposure.

The NDVI index was originally developed to enhance the herbaceous-shrub vegetation, but it becomes saturated in dense vegetation, while NDRE allows the distinction of nuances between forages with different vigor and the noise represented by the soils. The CIgreen enhances important aspects of green vegetation, which often does not occur effectively when the vegetation reflects a lot, or significantly, in blue or red.

The objective of this study was to create a technical feasibility study for the use of UAV in the estimation of biomass, forage canopy height, and vigor of plots of *Cynodon* grass and, thus, to develop a method that associates vegetation indices, height and volume of plants to estimate the vegetative vigor of cultivars.

II. MATERIALS AND METHODS

The study was conducted at the José Henrique Bruschi Experimental Field located in Coronel Pacheco (MG). The aerial surveys were carried out using a flight plan for the Inpire 1 drone, aiming at high accuracy using geodetic GPS control points collected in experiments of *Cynodon* spp. clones (Figure 1). Field trials were carried out with the indices VARI, GLI, CIgreen, NDVI and NDRE with a SenteraTM multispectral camera in the pasture plots.

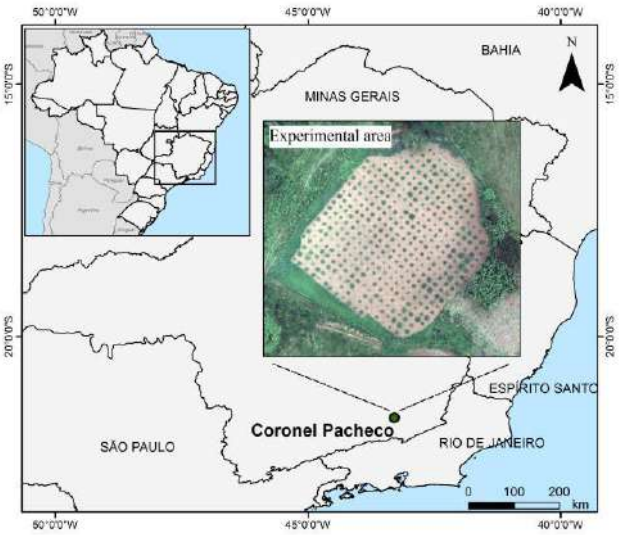

Fig. 1: Location of the experimental area

The method used was developed for the use of UAV with stereoscopic imaging, forage height and volume, as well as spectral response and vegetation indices combined with field survey data, as well as the estimation of an indicator of vegetative vigor in GIS. Using descriptive analysis and the Jenks Natural Breaks Classification in GIS, the superior class was defined with the best combination of vegetation and volume index for the plots of *Cynodon* spp.. The cultivars in this study are mostly derived from hybridization between *Cynodon nlemfuensis* and *Cynodon dactylon*. This method aims to build a differential in the estimates of agronomic correlations, aiming to replace the interpreter's perception in determining grass vigor, which may vary according to the technician's knowledge and experience.

Therefore, this method developed for the use of on-board equipment will be able to standardize the estimates, using an automated procedure and providing image processing using a multi-criteria approach, since it is based on several layers of data related to grass vigor, fresh weight, technician´s score, vegetation index, and forage volume (m^3).

Empirically, all classes of vegetation indices mentioned, VARI, GLI, CIgreen, NDVI and NDRE were estimated. Thus, in virtue of the characteristics of greater accuracy in the differentiation and details revealed in the vigor of herbaceous vegetation with the hyper-resolution cameras, we used the NDRE index (Equation 5) to apply the method. Therefore, the equation from the data collected is as follows:

$$VVI = \left(\frac{V - \bar{V}}{\sigma_V}\right) + \left(\frac{N - \bar{N}}{\sigma_N}\right) \qquad \text{(Eq. 6)}$$

Where: VVI is the indicator of vegetative vigor of the experimental plots; V is the mean plot volume and N is the mean NDRE for each plot, $\bar{V}$ is the mean volume for the entire set of plots and $\bar{N}$ is the mean NDRE for the whole set; both σ_V and σ_N are estimates of the volume and the NDRE standard deviation, respectively, for the experimental plots.

Thus, a method was developed that estimates the sum of standardized anomalies between the volume and vegetation index for the set of grass plots, and from the results, the best scored plots were selected, compared to the use of vegetation index alone, and comparing them to the technician´s scores, which ranged from 0 to 5.

This method was used in an experiment in the genetic improvement program of the genus *Cynodon*, in the augmented block design according to Federer. The experiment consisted of 8 augmented blocks, each block with 48 non-common treatments and two controls (common treatments Tifton 85 and African star-grass), with the exception of the last block, which consisted of 47 non-common treatments, added to the two common treatments, totaling 399 plots identified by number. At the time of cutting, the plots were scored for vigor, height was measured, and fresh matter of each plot was weighed.

The objective of this study was to create a technical feasibility study for the use of UAV to estimate the correlation of fresh matter production, forage canopy height and vigor of *Cynodon* spp. in the experimental plots. Vegetation index and volume were used through the radiometric and morphometric approach by NDRE index and GIS operations using the digital terrain model (DTM) and digital surface or elevation model (DSM) to derive an anomaly index directly related to vegetative vigor. Visible (RGB), red edge (RedEdge) and near infrared (NIR) imaging cameras were used for continuous monitoring of the experiment conducted at the José Henrique Bruschi Experimental Field (CEJHB), in Coronel Pacheco-MG. The study incorporates a standard procedure in the execution of surveys, with flight planning in the equivalent area and surroundings, due to the need for information outside the limits of the area of interest, in addition to the need to establish a series of parameters regarding the configuration of the FieldAgent™ system used for the UAV (Figure 2).

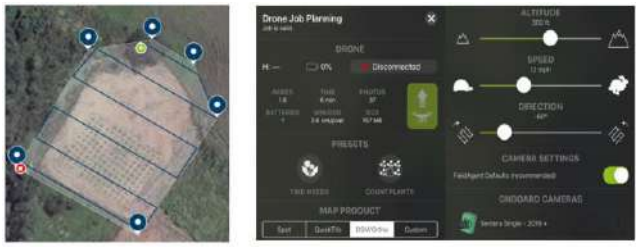

Fig. 2: Experimental area (A) and configuration of the FieldAgent™ system for UAV flight planning (B)

III. RESULTS AND DISCUSSION

Consistent with the planning of the UAV imaging operations, an accurate flight was performed. Weather conditions were considered, such as wind speed, rainfall, etc …, favoring good sun light, necessary to standardize the surveys in the experimental areas. One of the most important phases, the pre-survey, consisted of the marking of geodetic control points, which was essential for good final accuracy. From these points, a GSD (Ground Sample Distance) of 2.6 cm on the ground and excellent positional accuracy was obtained, allowing for image overlapping with the same experiment in future flights.

After image processing, by stereoscopy and resampling to 15 cm, DTM and DSM were determined with the altimetric and volumetric estimation of the plots by the difference between the models, selecting the NDRE as the most suitable vegetation index to estimate vigor compared to the other indices tested (Figure 3). From the correlations between the classification of the clone fresh weights in the plots, the scores, the NDRE and the volume, a comparison parameter was established based on a ranking of clones with the best score. This score, obtained from the vigor measurements, led to the construction of a ranking, from which the best forages in terms of vegetative status, size and vigor were selected.

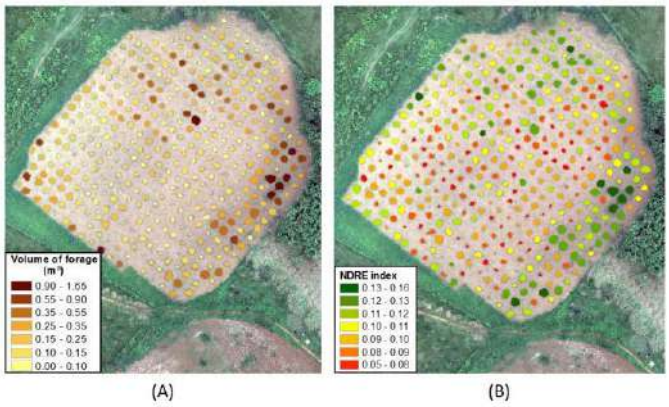

Fig. 3: Map generated from the forage volume (A) and NDRE indices (B)

The NDRE by itself did not provide a good correlation of the scores and fresh weight, according to the data in Table 1 (scores assigned are in parentheses and the letter T represents the control, which is Tifton grass cv 85). It is noted that without all the parameters, which would include the volumetric information (DTM - DSM), the Tifton plots appear in this classification, even if the control grass is used for comparison with the treatments applied to forages in genetic improvement. Thus, the multicriteria approach, which recommends the crossing of layers of information, resulted in a better correlation, and, therefore, the most appropriate selection of these forages. Table 1 also shows the classification of plots using the VVI, which took into account the sum of standardized anomalies between volume and NDRE for the set of *Cynodon* spp. plots.

Table 1. Ranking of forages in the experimental plots by NDRE and VVI

Classification							
NDRE				VVI			
Rank	Nu Plot	Score	Fresh Weight (kg)	Rank	Nu Plot	Score	Fresh Weight (kg)
1st	[T] 385	4.0	1.38	1st	269	5.0	3.10
2nd	[T] 68	5.0	3.60	2nd	305	4.5	2.44
3rd	[T] 270	4.0	2.04	3rd	268	5.0	2.64
4th	305	4.5	2.44	4th	265	5.0	2.68
5th	206	4.0	1.60	5th	277	5.0	2.44
6th	[T] 213	3.5	1.38	6th	319	5.0	1.50
7th	[T] 309	4.0	1.45	7th	68	5.0	3.60
8th	265	5.0	2.68	8th	309	4.0	1.45
9th	269	5.0	3.10	9th	3	3.0	1.71

[T]Tifton cv 85.

Figure 4 illustrates the geographical distribution of the plots with the results of the method used, as well as the classification of the forages, considering the 9 best ranked by the Jenks Natural Breaks Classification, which is highlighted in dark green.

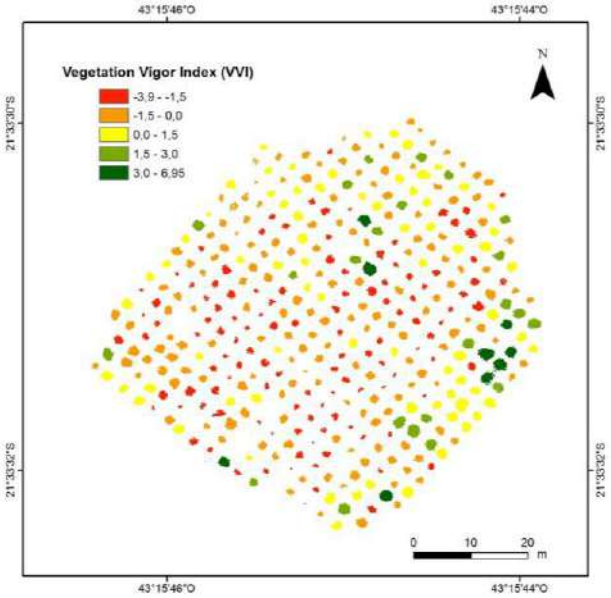

Fig. 4: Map generated using NDRE and measurement of forage volume

IV. CONCLUSION

The UAV provided, in a first approach, a fast and efficient capture of information of the plots in the field by remote sensing, and, through the application of the radio-morphometric approach and the VVI method, a standard was established in the estimates of agronomic parameters for the genetic improvement of *Cynodon* spp. clones. This can greatly contribute, for example, to high-throughput phenotyping in plant breeding programs. This probably constitutes a new knowledge frontier for applications in aerial photogrammetric surveys and extracting of biophysical parameters in crops, phytosanitary issues, and anticipation of stresses that may involve water, mineral nutrition, or entomological aspects. Applications in infrastructure and exploratory mapping will emerge with more strength as the UAV becomes popular in academia and farming.

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Female Participation in Agribusiness: A Bibliometric Analysis of the Scientific Production of the Web Bases of Science and SciELO in the 2010-2020 Period

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Abstract *- Brazilian agribusiness has played a key role in the country's economic development in recent decades. Female participation in agribusiness showed positive results. Although there is the discourse of equal opportunities, the inequalities concerning the participation of women in relation to men in agribusiness are explicit, both in relation to remuneration, leadership, ascension and even in the opportunity to perform certain functions. Although there is still some discrimination, women are managing to overcome the various barriers imposed, seeking empowerment in the field and strengthening the importance of their role in agribusiness. This work aims to relate the quantity and quality of scientific articles that make the connection of agribusiness with female participation, through research platforms Web of Science and SciELO, bringing a positive result in the research, where it is possible to visualize the increase and importance of women's participation and leadership in agribusiness.*

I. INTRODUCTION

The importance of agribusiness to the Brazilian economy is recognized worldwide. However, its conceptualization is somewhat complex, since it goes beyond the limits of the field, uniting agricultural, industrial and service activities.

Such concept can be further explained [1]:

> Agribusiness is thus not limited specifically to the plantation and cultivation of agricultural commodities (sugarcane, soybean, corn, wheat, coffee, etc.), although this activity is at the center of the agribusiness network. They also integrate the production and marketing of seeds, fertilizers and other inputs, distribution, storage, logistics, transport, financing, quality conference and other services, as well as the use of waste of economic value. It is, in fact, the rational interconnection of all these economic activities that make up agribusiness, not each of them separately. Agribusiness is the network in which the rural producer (who knows how to plant and harvest soybeans, but does not understand and does not want to be exposed to the risks of price variation), and trading (whose expertise is the international market for

> agricultural commodities, and the financial instruments that can save rural producers from price fluctuations). Each one, taking care of what he knows how to do best, contributes to the full efficiency of the rational integration of the business network.

Agribusiness is the expression that results from the merger of agriculture or agriculture and business. The term business originally comes from the Latin *negotium* and has the meaning of occupation or work which aims at satisfying desires or needs. The term agribusiness relates to activities or work related to agriculture. It can be understood as the generation of value of the product or service through labor. [2].

Agribusiness is considered as one of the driving forces of the national economy [3].

The word agribusiness or agrobusiness, refers to the unification of various productive activities, which have direct or indirect link to the production and subproduction of agricultural and livestock products. Agribusiness is not only an isolated action in the field but a set of actions that can be observed, identified in a production chain that go beyond fences and fences [4].

It is true that development is closely linked to the modernisation of agriculture. [5], tracing a history of the modernization of agriculture in Brazil, points out that this occurred during the military dictatorship, through the resumption of public policies focused on the creation of a very technical agriculture.

[5], this with a view to "expanding agricultural borders, granting credits and subsidies to the sector, using new technologies and privileges to export products or linked to energy programs, such as Proálcool".

Agribusiness is recognized as an important driver for Brazilian economic growth. The sum of goods generated in agribusiness reached R$ 1.55 trillion, or 21.4% of the GDP (Gross Domestic Product), Brazilian [6]. Among the segments, the largest portion is in the agricultural sector, which corresponds to 68% of this amount (R$ 1.06 trillion), and livestock corresponds to 32%, that is, R$ 494.8 billion [7].

However, in 2020, the emergence of a new disease, called COVID-19, shook the structures of several economic sectors, including agribusiness.

The GDP registered a decrease of 4.1% in 2020, compared to 2019, affected by the coronavirus pandemic. This fall stopped growth three years in a row, from 2017 to 2019, when GDP accumulated a high of 4.6%. In the fourth quarter, GDP showed an increase of 3.2% in comparison with the previous quarter, but registered a decrease of 1.1% in relation to the same period of 2019 [8].

It is added that agribusiness is a sector that has been essential to sustain economic activity during the pandemic. And according to Tereza Cristina, Minister of Agriculture, Livestock and Supply of the country, in an interview to the Program The Voice Of Brazil, in august 2020, agribusiness was the engine of the economy, and managed not to let the GDP fall, being a generator of wealth for the internal market, for exports and employment.

Agribusiness is one of the sectors that have been generating dividends in Brazil, which attracts men and women in the search for a better professional position.

There is a growing female participation in agribusiness, as they advance in leadership positions and also stimulate the use of technology in the field [9].

About 40% of agribusiness workers are women, there is an increase in the female presence in this segment by 8.3%, while male participation decreased by 11.6%, that is, about 384,582 women took new jobs related to agribusiness and, on the other hand, approximately 1.65 million men left the agricultural sector [9].

Most women work in agribusiness (34.11%), or in agribusiness (45.32%), and only 19.66% work inside the concierge. Consequently, this is related to the fact that 80.94% of women live in the urban area - where agroindustrial and service jobs predominate - and only 19.06% live in the rural area [9].

There is an increase in female participation in this activity. However, it is still possible to verify in agribusiness, their invisibility in terms of work and management, since they are important protagonists in the implementation of various activities of the property and in the maintenance of the family [9].

Considering the context, this article chose the following guiding question for the development of the study: How is the evolution of the field of study on female participation in agribusiness being presented?

The accomplishment of this work had the personal motivation to identify the profile of these women facing the challenges of leading companies and teams, given the difficulties encountered due to gender issues. And the other aspect was to demonstrate the importance of this research, related to the lack of projects and works on the proposed theme.

With this context, this article aimed to know the "State of the Art" of knowledge production related to the theme "Female Participation in Agribusiness", based on the academic production of articles published in the research

databases: Web of Science and SciELO, from 2010 to 2020.

It is justified to conduct the study from two perspectives, the first academic, Brazilian research on female participation in agribusiness, which are recent and involve issues related to the difficulty of entering management positions, prejudice in the organizational environment and conflicts between the double shift, home, work, children [10].

It is noticed that the theme related to female participation in agribusiness is little explored. In addition, female leadership in agribusiness has also emerged with greater force, due to the perspective of the professional insertion of women in leadership situations.

To make the study possible, an exploratory research was carried out through the survey of articles on the female participation in agribusiness in the publications of two research bases, one of universal character, the Web of Science, where it has a huge collection of scientific productions from all over the world, and the second, SciELO, also open for research with work from several countries in Latin America.

Theoretical Reference

In this chapter, the importance of Brazilian agribusiness will be presented, the scenario of agribusiness in the São Francisco Valley. Then a general overview of women in the labour market will be reported. Finally, by connecting these two main themes, the context of women's participation and leadership in the agribusiness labor market is explained.

1.1 The Importance of Brazilian Agribusiness

Agribusiness involves activities that take place throughout the production chain [11].

Corresponds to all economic activities related to production, presenting great importance to the global economy and is one of the economic pillars of Brazil [12].

Agribusiness functions as an economic sector, given its importance to the economy and society. This is due to the involvement between the food production chain and its intimate interaction with the most varied sectors, such as agriculture, livestock, industry and service provision [13].

In the last two decades, the development of Brazilian agribusiness, promoted an explosion in growth, driven by the dizzying increase in production, allowing Brazil to establish itself as one of the most important suppliers of food to the world [14].

The increase in production contributed to the reduction of food prices, contributing to the improvement of the population's quality of life and health, with greater purchasing power [15].

Agribusiness is recognized as an important driver for Brazilian economic growth. The sum of goods generated in agribusiness reached R$ 1.55 trillion, or 21.4% of the Brazilian GDP [6]. Among the segments, the largest portion is in the agricultural sector, which corresponds to 68% of this amount (R$ 1.06 trillion), and livestock corresponds to 32%, that is, R$ 494.8 billion [7].

As for the Brazilian export, in 2019, 43% of the total exported were agribusiness products, demonstrating its importance and contribution to the growth of the Brazilian economy. Brazil is the largest exporter of sugar, coffee, orange juice, soy beans, beef, chicken and the third largest of corn, and the fourth of pork [7].

Brazil is in the fourth position of the world's largest exporter of agricultural products, behind only the United States, China and the European Union. And this growth contributed significantly to the macroeconomic stability of Brazil [16].

However, in 2020, with the emergence of COVID-19, it agitated the structures of several economic sectors, including agribusiness. This situation caused several sectors to suspend their activities, generating negative economic impacts resulting from the new coronavirus crisis, related to social isolation, thus reducing production and increasing consumption.

The effect of isolation immediately affected the flow of inputs and Brazilian agricultural production, causing logistical problems and loss of production [17].

However, agribusiness, despite the production demand, the interruptions in the agri-food markets, which affected the production and availability of food, still managed to maintain the active capacity of generating wealth and income, maintaining not only its productive sector, but also, sustaining the national economy, plagued by economic devastation [18].

Thus, even amid the scenario of the crisis caused by COVID-19, Brazilian agribusiness has presented satisfactory results, which show mitigation of the impact suffered by the national economy, which should be the reason for the recovery [19].

The Brazilian agribusiness once again proved to be a strong sector, presenting good results amid a period of economic downturn, numerous challenges caused by COVID-19. Despite the numerous impacts experienced by agribusiness, the sector stood out, with positive results.

1.2 Agribusiness in the San Francisco Valley

The São Francisco Valley Submedio (SMSF) is located between the west of the state of Pernambuco and the north of the State of Bahia, with a semiarid tropical climate, and area of more than 360 thousand irrigable hectares [20].

The same has been noted for the production of fruit for export. The irrigated area of the Valley was 360,000 hectares in 2013. The region is considered the third largest fruit producer in the world, producing 43.8 million tons per year [20].

The world consumption of fresh fruit is of the order of 42 million tons per year, moving US$ 28 billion annually. Brazil participation, on the other hand, is in the order of US$ 642.7 million (2.3%). Of this total, the São Francisco Submedio participates with 39.1%, mainly exporting grapes and mango, being responsible for a total of US$ 251.5 million. 80% of the grapes and 65% of the mango exported by the San Francisco Submedio go to the European Union, 15% of the grape and 30% of the mango go to the United States and the remaining 5% of mango and grape go to Canada, countries in Asia, South America and the Middle East [20].

Thus, the São Francisco Submedio, a region that includes some cities of these two States, is known as the most prosperous region of the northeastern interior, which is totally in the semiarid zone of the Brazilian Northeast.

Agribusiness is one of the most important sources of wealth in Brazil. The importance of Brazilian agribusiness places the country among the most competitive nations in the world in the production of agro-industrial commodities, with enormous potential for horizontal and vertical expansion of supply. It is the result of a combination of factors, among them, mainly investments in technology and research, which led to exponential increase in productivity [21].

1.3 Women in the Labour Market

According to the International Labour Organization (ILO), although the presence of women in the labor market has increased significantly, they were to a greater extent in "part-time work, informality, sporadic employment and self-employment" [22].

Data from the National Household Sample Survey (PNAD) reveal that between 2002 and 2015, the Rate of Female Participation in the Work Force (TPFT), grew approximately 3 percentage points, reaching 40% in 2015. Female presence has been increasing over the years [9].

Even with this growth, a part of women still have to go through difficulties that many men do not find, such as the balance between domestic activities versus out-of-home employment and wage difference. Even with greater challenges, most of these women struggle daily to maintain or even create their space in companies. Also according to the ILO, "Women earn 17% less per hour than men and, despite the increase in female participation in the labor market, are still far from equity" [23].

In 1950, only 13.6% of women were economically active. In the same period, the index of men reached 80.8%. Sixty years later, data from 2010 showed that female participation more than tripled to 49.9%. Among men, on the other hand, the figure dropped to 67.1% [24].

In view of this, we can see the female struggle against the setbacks in her achievements and, above all, for the right to be able to go out on the street, to walk on public transport without being harassed, be beaten or raped and so that no right won with so much struggle and resistance is withdrawn. Today, more than half a century after the "First Feminist Wave", the movement has amplified and divided into several others. His subject no longer boils down to the white woman, middle class, who fights for civil rights: it is also the black, the mother, the periphery, the young, lesbian, trans [25].

Thus, while significant wage inequalities between men and women in the same capacity remain, it is undeniable that feminist criticism of inequalities in the labour market played an important role in the intense occupational diversification, experienced by women in the last three decades [26]. The integration of women occurs almost exclusively by their own effort, due to the rapid change of mentality through which our society passes [27].

Also, it is important to highlight that the women's movement in Brazil is one of the most respected in the world, standing out for the decisive contributions in the process of democratization of the state producing, including, important innovations in the field of public policies [26].

Therefore, the struggle of women is of extreme importance to decrease the gender inequalities that remain in our society and ensure the creation and implementation of public policies in favor of women and progress in terms of gender equality in the labor market.

1.4 Women participation in agribusiness

The participation of women in agribusiness is still a theme little explored in the academic field, as well as little perceived by the economic and political agents of the country, although women have increasingly played a decisive role in increasing the sector's competitiveness.

Women have always worked in the field, but in recent decades have managed to conquer more space and assume leadership positions in Brazilian agribusiness [28].

Historically, the work done by women was seen as invisible to society and often, in addition to the work intended for the family and the home, they "helped" their husbands with the activities in the field. Women have gained a lot of space in the labor market, but gender equality is still far from being achieved.

Agribusiness historically has a greater involvement of men despite the fact that there has always been the participation of women in this area. However, women in agribusiness have sought their space, seek to professionalize themselves, have a holistic view of the field and seek recognition of their work, which was formerly invisible to society.

Men are assigned primarily to activities linked to the productive sphere, while women to the reproductive sphere, and at the same time there is a greater appreciation of male work and they perform the activities of higher added value [29].

A survey commissioned by the Brazilian Agribusiness Association (ABAG), entitled "All Women in Agribusiness", outlined the profile of these producers and the important role they have played for the agricultural harvest in Brazil, dividing into place of operation and type of work developed, as shown below [30]:

Table 1: All Women in Agribusiness Survey

PLACE WHERE THEY OPERATE	
MINIFÚNDIOS	49,5%
SMALL PROPERTIES	26,1%
AVERAGE PROPERTIES	13,5%
LARGE ESTATES	10,9%
TYPE OF WORK CARRIED OUT	
INSIDE THE FARM	73%
COOPERATIVES	3,7%
AGRICULTURAL INPUTS	3,4%
FUNCTIONS RELATED TO THE SUPPLY OF SERVICES AND PRODUCTS, TRADE, GOVERNMENT AND OTHER ACTIVITIES RELATED TO AGRIBUSINESS	9,3%

Source: ABAG, 2017

The number of women running rural properties in Brazil reached almost 1 million. 947,000 women responsible for managing rural property were identified, out of a total of 5.07 million. The majority are in the Northeast (57%), followed by the Southeast (14%), North (12%), South (11%) and Midwest, which concentrates only 6% of the universe of women leaders [24].

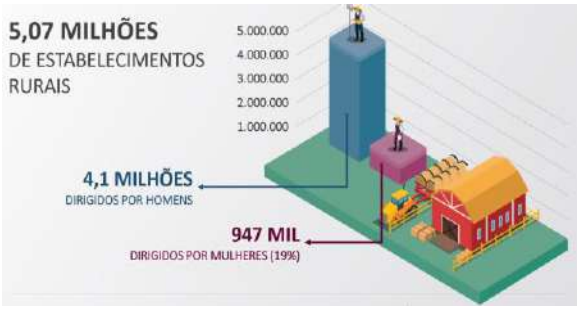

Fig. 1: Results on Rural Women

Source: IBGE, 2017

According to the survey, together they manage about 30 million hectares, which corresponds to only 8.5% of the total area occupied by rural establishments in the country.

From 1991 to 1998, only 1% of rural properties had a woman in charge of decision-making. Currently, this percentage reaches 10%. In addition, the salaries received by women are unequal to those received by men [31]. Women receive about 78.3% of what is paid to men [32].

The number of women working in agribusiness between 2004 and 2015 grew by 8.3%. According to the study Women in Agribusiness, the biggest impetus for this to happen was due to the actions of women over 30, married and with a higher level of qualification [9].

There is evidence that this behavior may be partly related to the historical factors that have marked the agricultural organization differently in the various states, and the Northeast region stands out for presenting a rather unfavorable scenario to women's participation in agribusiness [33].

Important improvements have occurred in the participation and profile of women in agribusiness in recent years, such as the increasing level of education of female workers, the higher degree of formalization of employment and the good level of job satisfaction [33].

However, despite the positive developments cited, other aspects still need attention, such as the hierarchical level of positions usually occupied by women in agribusiness, as well as the gender pay gap and numerous other points to be adequate.

The profile of those who work in the agricultural segment has been evolving over the years. Nowadays, men and women perform similar activities in agriculture and livestock.

History shows that the achievement of the recognition of women's work has been arduous but rewarding [34].

Women are working in the different activities that make up agribusiness, and are increasingly present as successors, collaborators and entrepreneurs. They have sought more and more professionalization, since the academic training, in the areas of veterinary, agronomy, administration, zootechnics, which are mostly composed of men, until the specialization, in masters, doctorates or vocational courses.

1.5 Female Leadership in Agribusiness

Traditionally the role of leadership has been attributed to men and, despite the emergence of new social behaviors such as gender equality, the representation of men and women in leadership positions presents another reality. The role of leader is still tied to the male sex, which generates inequality regarding the position of power and prestige [35].

The female leadership has suffered a decline in the last 5 years and, in contrast, has increased the number of men hired in Brazilian industries. With this data, a gap is opened to be studied and analyzed to try to understand what the path taken by women for the development of their career and the legitimization of their leadership. In agribusiness, 23% of Brazilian families have female leadership. Regarding agribusiness management, in Brazil 27% of leadership positions are held by women [24].

19% of working women are self-employed. Of the professionals who work up to 30 hours, women are already the majority, being 28.2% women and 14.1% men. In relation to salary, still men, on average, receive higher salary, getting R $ 2.300,00 for them and R $ 1.700,00 for them [24].

Inequality in senior positions between men and women. They represent 62.2% and they represent 37.8%, but the difference is smaller when it comes to younger women, and in the population between 16 and 29 years, women in managerial positions represent 43%, and between 30 and 49 years represent 39.5% [24].

II. METHODOLOGY

Considering that the objective of this study is to know the "State of the Art" of the production of knowledge related to the theme "Female Participation in Agribusiness" based on bibliometric indicators, different actions were necessary for the design of the research.

First, the bibliometric review makes it possible to collect, select and critically analyze studies, for example, academic articles from studies available in a database can be considered as the source of a bibliometric study.

Bibliometry is the application of quantitative and qualitative methods. Study of quantitative aspects of scientific production, dissemination and use of available information. It creates mathematical patterns and models for measuring scientific production [36].

Bibliometric research investigates the productivity of individuals present in the scientific and technological environment, through the categorical evaluation of bibliographic and reference sources, the relations and patterns of organization, as well as critical points, trends and counterpoints [37] [38].

The research used two databases of bibliographic production, the Web of Science (WoS), and the Scientific Electronic Library Online (SciELO). The first is a multidisciplinary foundation developed by Thomson Scientific - Institute for Science Information (ISI). The choice of WoS for data collection was based on its tradition and scope, besides being internationally used for macro analysis of scientific production. We also consider the fact that it includes the names of all the authors of the published works and information about the institutions and the country of origin of the authors, allowing analysis of collaboration patterns, the second research base, has more than 20 years of regular operation, in open access with peer-reviewed scientific journals, and to cover 15 Ibero-American countries, in addition to South Africa.

This research is characterized as empirical-analytic, with an approach at the descriptive and exploratory level, since it seeks to identify aspects not yet explored with regard to the aforementioned theme. The facts will be observed, recorded, classified and analyzed.

Qualitative and quantitative research methods were chosen. Qualitative because it adopted the collection of data from the analysis of the content exposed in the journals that contained the articles read, and an analysis of content was made through the research in the texts. It is quantitative because statistical techniques will be applied to analyze scientific production.

The work was carried out in four stages, the first phase, in order to provide support for the accomplishment of the work, a bibliographic survey process was carried out in several sources (books, articles and scientific journals, theses, dissertations, among others)and the constitution of the theoretical foundation that will permeate the stages of research. The second stage consisted of the collection of scientific articles dealing with women's participation in agribusiness published in the last 10 years, from 2010 to 2020 in the databases chosen for the work, based on specific keywords for the research.

The third phase, with a quantitative focus, was used descriptive statistics for the creation of indicators and organization of data essential for the understanding of variables. Based on this, the quantitative analysis was

made divided by areas of knowledge, and soon after these areas were grouped, thus generating new indicators for analysis, it was also carried out by research base, where the WoS and SciELO numbers are shown.

The following terms were used to meet the objectives of the research: I - ((AGRIBUSINESS) AND (FEMALE)) II - (((SAN FRANCISCO VALLEY) AND (AGRIBUSINESS)) III - ((AGRICULTURE) AND (FEMALE)), collecting the data in the two databases mentioned, WoS and SciELO. After the collection, the data were tabulated and analyzed, thus generating an answer to the initial question of the article.

In the fourth and final phase, the analysis and discussion of the data obtained in the bibliographic survey was carried out, observing the relations between the themes addressed in the research problem and the comparative aspects between the results obtained between the two databases chosen.

III. RESULTS AND DISCUSSIONS

In total, 175 searches related to the theme of the *Woman* and *Agrobusiness*, each 165 newspapers on the basis of WoS and 7 on the basis of SciELO, as shown in figure 2.

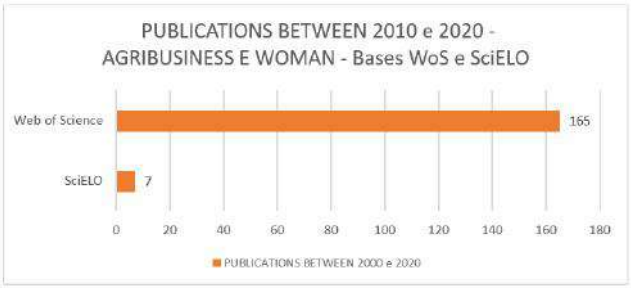

Fig. 2: Publications Between 2010 to 2020 - Lean Manufacturing and Agribusiness - Bases WoS and SciELO

Source: Elaboration of Own Data From the WoS and SciELO Databases

It is possible to see the increase in the number of publications over the years, and the theme being inserted in the context of agribusiness publications.

Table. 2: Number of Records Obtained in the Searched Databases

Web of Science (WoS)		SciELO	
2020	29	**2020**	
2019	30	**2019**	
2018	30	**2018**	1
2017	18	**2017**	1
2016	22	**2016**	2
2015	16	**2015**	1
2014	7	**2014**	1
2013	1	**2013**	-
2012	6	**2012**	1
2011	4	**2011**	-
2010	2	**2010**	-

Source: Elaboration of Own Data from the Database (WoS and SciELO)

Analyzing these articles, we notice a small amount of the articles found in Brazil, while the others were published in international journals, in countries such as the United States, China and some European countries, as can be seen in figure 3.

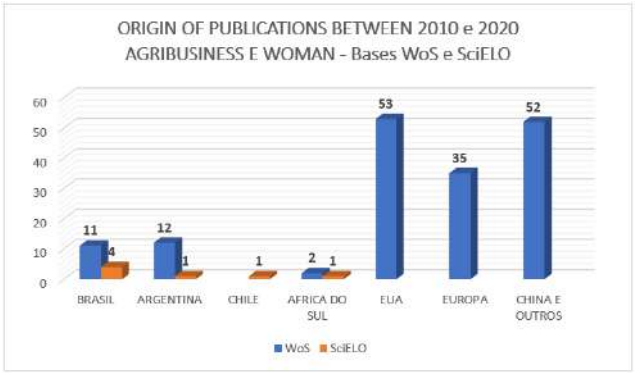

Fig. 3: Origin of Publications Between 2010 and 2020 - Lean Manufacturing and Agribusiness -

Bases WoS and SciELO

Source: Elaboration of Own Data From the Web of Science and SciELO Database

In 2020, twenty-nine articles were found on the WoS platform, and analyzing some of the articles with the topics researched and published in Brazil, The main points of each one were highlighted in Table 3.

This review of the literature makes it evident that the female participation in agribusiness, even though it is still little explored and often underestimated, is of paramount social and economic importance. In addition to growing over the years, as shown by studies, the female labor force has grown in the sector.

Table. 3: Some Articles Found in The Year 2020

COUNTRY	ARTICLE	MAIN POINTS
Brazil (BR)	BUTURI, D., GARCIAS, M.. Women's Labor Market in Paranaense Agribusiness. Agricultural Policy Magazine.	It analyzes the profile of women who work in agribusiness in Paraná, focusing on the socioeconomic aspects of women workers. It uses as the main database Pnad and, in a complementary way, CNAE 2.0 and information from CEPEA and Rais.
Brazil (BR)	AF Marques, FC Pierre - Women in Agribusiness - IX JORNACITEC.	Insertion and the main challenges of women in agribusiness.
Brazil (BR)	VERONEZZI, Fernando; SERRA, Elpidio. Participation and Female Protagonism in the Family Agriculture Training Programs in São Paulo State. Geo UERJ.	Female Protagonism and the Mastery of Commodities Production.
Brazil (BR)	CALADO, Camila; SILVA, Valéria. Agriculture, Gender and Social Reproduction: Lifestyles of Rural Women in Contexts of Agribusiness Expansion. ECO-Post Magazine, v. 23, n. 2, p. 79-107.	It analyzes the impacts of agribusiness on the ways of life of women in rural areas of Vale do Brejo Prata/Sebastião Leal/PI.
Brazil (BR)	SILVA, Brenda Ribeiro da; REDIN, Ezequiel. A woman's place is where she wants it: The challenges of Women in the Agribusiness Labor Market. Study & Debate Magazine.	Analisa a atuação das mulheres que ocupam cargos no âmbito comercial em organizações dos agronegócios.
Brazil (BR)	SANTOS, Sérgio Silva dos. Rural Women Empowered by The Use of Digital Technology. 2020.	Women, Cooperativism and Digital Transformation.
Brazil (BR)	BATISTA-CRISTIANE, CRISTIANE; BENCKE-FERNANDO, Fernando Fantoni; PADILHA, Luccas Santin. Legitimization of Leadership and Mobilized Capitals: History of Life of Female Leaders of a Large Agro-industry.	It analyzes Women's Leadership, Mobilized Capitals, Legitimation and Life History.
Brazil (BR)	BRITO, Carina de Moraes Pereira; DO NASCIMENTO, Priscila Brasileiro Silva. Agroecology and Empowerment of Women From a Rural Community in the Semiarid Region of Bahia. Journal of Public Policy and Educational Management (POLIGES), v. 1, no. 1, p. 140-166.	Agroecological experiences developed within a solidary productive group have contributed to the advancement in the search for female empowerment in a rural community of the Bahian semiarid.
Brazil (BR)	GUBERT, Flavia Piccinin Paz et al. Women's Empowerment in Family Farming.	Gender, Women's Empowerment, Family Agriculture and Sustainable Development.
Brazil (BR)	RODRIGUES, Helder Epifane. Female Entrepreneurship in Rural Pará: Study With Family Farmers in Municipalities of Baixo Tocantins. 2020. Doctoral Thesis. UFRA/Campus Belém.	Gender equality and women's empowerment.

Source: Elaboration of Own Data From the Web of Science Database (WoS)

As for the areas of elaboration of the articles, the predominance in the field of agricultural sciences is seen. But applied social sciences also has its role in the contribution of the production of articles focused on this theme.

Thus, the difficulties and unequal treatment between men and women persist, with the need for public policies to solve problems such as functional machismo, low wages and double working hours which are linked to the lack of appreciation of them by the market, even though women are qualified.

IV. CONCLUSION

This study aimed to perform an analysis of the panorama of publications on women's participation in agribusiness through a bibliometric study. Survey done with farmers in 17 countries by Corteva Agriscience (is the new name of the agricultural division of Dowdupont), reveals a slow progress of women in agribusiness, a segment where financial disparity, lack of recognition and poor access to training are the main obstacles. In Brazil, almost 80% of respondents say that there is gender discrimination in agribusiness and almost 50% report earning less than men - a worse perception than in other countries, whose average is 40%. Despite this, 63% of Brazilian women said that there is currently less discrimination than 10 years ago and 44% believe that the country will take one to three decades to achieve equity [39].

Therefore, it can be inferred that the participation of women is essential, in all cultures, to keep afloat the world production of food and that its action is growing in the various segments of the agro-industrial sector, from farming to business management. In this sense, it is understood that companies in the agro-industrial sector, attentive to this reality, should insert and promote actions and strategies aimed at women in the sector.

When conducting the research, it is noticeable the growth in searches among researchers from all over Brazil, in which we have articles published in several universities in the country.

The assessment made by this study mirrors the still embryonic participation of research in the theme addressed, within SciELO in the period 2010 - 2020, the platform represented only 5,71% of the total of the works obtained in the two databases analyzed from the filters applied and detailed in the methodology of this work, having, the Web of Science, answered by 94.28 of the total of these works (175).

It can be seen that the increasing evolution of female participation in the labor market, as well as, the importance of female insertion in all sectors of the economy are facts proven, both by the indexes pointed out by government agencies, as for the numerous studies developed by researchers on gender issues.

However, there are many challenges and difficulties faced by women in the conquest of a space in the labor market, mainly in relation to cultural issues of the role assumed by women, mother and "housewife", allied to formal work, paid and whose vacancies are predominantly occupied by men.

The objectives outlined at the beginning of this investigation to know the "State of the Art" of the production of knowledge related to the theme "Female Participation in Agribusiness", based on the academic production of articles published in the research bases were met in their entirety, given the intended exploratory and descriptive character.

However, once the objectives of this study are achieved, it is suggested the continuity of this research agenda, as it is a matter of relevance in the present day, it is necessary to obtain more instruction on this subject, seeking to deepen new aspects to broaden the understanding of the specificity of female leadership in this sector.

It is possible to infer that the presence of women in agribusiness is a trend and the gains in terms of competitiveness and productivity tend to increase with the greater participation and engagement of women in different agricultural activities, both in production and management. Finally, even though the true contribution of women to agricultural economic production is still sometimes underestimated, the considerable progress achieved in relation to the insertion of women in agribusiness and gender mainstreaming in agricultural statistics is visible and growing.

Like any scientific work, it is also not without limitations. Like any scientific work, it is also not without limitations. The main one refers to the scarcity of publications focused on the subject and a theoretical contribution that founds it.

However, this is a limitation of methodological nature and not a practical limitation, since the actions aimed at the insertion of women in agribusiness really exist. Thus, it can be said that the limitation of this work is part of the process of construction of knowledge on the subject.

Finally, it is necessary to promote alternatives for the participation and empowerment of these women, based on technical assistance, public policy-making and projects that assist in the demystification of women's work, valuing and recognizing the role of women in the development of agribusiness in the region.

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Experimental tendon rehabilitation model, histologic stages of healing associated with tensile strength restoration

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***Keywords*— Collagen, histologic stages, Cartilage formation**

***Abstract*—** *The tendon repair process is the focus of a lot of current study. It is common to use histological and biomechanical tests to evaluate various gene therapy and tissue engineering procedures. There is some overlap between the two methods, but they have historically been viewed as two distinct things. To compare data from different research or even within the same study, there is no approved scoring scale for histological examination. Biomechanical testing can produce reliable results, but it comes at a higher price and requires more time and effort. An objective, verified scoring system for histological results and biomechanics was anticipated to be the best way to compare histolog ical findings. Histological grading scale for assessing tendon repair has been devised in Achilles tendon model. Angiogenesis, collagen orientation, and cartilage induction are graded by the system. Histology scores were plotted against biomechanical testing findings of healing tendons, and the results showed a strong linear association between histological qualities and biomechanical characteristics. Concurrently, this study presents a practical and financially possible way to evaluate repair while accounting for both the histology and biomechanical features observed in surgically repaired, regenerating tendon.*

I. INTRODUCTION

According to Yoon, et al., (2020), there are four stages of tendon recovery. A hemorrhagic phase occurs in the first few hours after a tendon is ruptured. The cytokines released by a blood clot attract polymorphonuclear leukocytes and lymphocytes, which fill in the void. The arrival of macrophages at 24–48 h marks the beginning of an inflammatory phase. Neovascularization and granulation tissue production are induced by the phagocytosis of necrotic tissue by these cells, which produce growth factors. During the third phase, fibroblasts enter and begin making collagen and matrix proteins. This occurs within the first week. Remodeling and maturation take place in the final stages of development. Healed tissue loses its cellularity with time, while the matrix thickens and becomes more longitudinally orientated. Type I collagen predominates, as does collagen turnover, water content, and the collagen I/III ratio, all of which return to normal levels at this point in the process. A recovery to normal collagen concentration

occurs during 12 to 14 weeks after maturation (Bulut, et al., 2020).

One of the most important areas of research in tendon restoration is the use of biological mechanisms to improve surgical repair of tendon injuries and influence the reported histological phases of healing. Validated outcome metrics are the only way to confirm the utility of these biological approaches. Direct readings from tensile testing devices now validate mainly biomechanical effects (Loder, et al., 2018). Pineda, the International Cartilage Repair Society, the o'Dris-col scale, and the Oswestry Arthroscopy Score are only a few of the objective grading systems for evaluating cartilage repair. However, there are no comprehensive, unbiased methods for determining whether or not a tendon repair was a success. To better understand tendinosis, Soslowsky and his colleagues devised a subjective scale to measure the severity of the condition (Shekha, et al., 2013). However, biomechanical testing has never been used to verify the efficacy of this strategy (Han, et al., 2020).

We could greatly benefit from the creation of a validated histological scoring system Another reference point would be used to remark on the results of investigations and to compare different repair methods. Animal research is also very pricey. An alternative to expensive biomechanical testing could be justified if histological scoring systems were found to correlate well with biomechanical outcomes. Our goal was to create a histological scoring system that could detect even the smallest variations in tendon composition and use that information to determine how the tendons' biomechanical qualities had changed (Jiang, et al., 2020).

A new histological grading system for evaluating the tendon–tendon healing process is described in this article. Since the results of biomechanical testing were expected to significantly influence our scoring system, we developed a new score called the Grande Histological Biomechanical Correlation Score (GHBCS), which we believe will accurately reflect the biomechanical strength of the nonruptured tendon. This score, we believe, will give researchers an additional tool for evaluating and comparing the results of tendon healing investigations (Liu, et al., 2018).

II. MATERIALS AND METHODS

Aseptic conditions were maintained during the surgical process. Scalpel transection was used to execute the midsubstance tenotomy. Recombinant Human Growth and Differentiation Factor 5 (rhGDF-5) sutures were utilized to heal Achilles tendons utilizing the Mason–Allen stitch technique. Each repair included an average of 2.9 centimeters of suture. Biomechanical testing was carried out on the tendons that were not surgically removed. The involvement of rhGDF-5 in the production and healing of tendons has been well described in previous research [5–8, 17]. [7, 8] We used the biomechanical and histological data from two of these earlier investigations to establish a grading scheme for this project.

The 96 rats were divided into two groups: a 3-week and a 6-week time period. Randomly assigned to one of four rhGDF-5-coated suture groups (n=12 in each group), the rats in each time protocol were assigned to one of the four growth-factor-coated suture groups (n=12 in each group). Each group had four rats tested for histology and eight rats for biomechanics. These allocations were kept a secret from the researchers involved in this investigation.

Following surgery, the animals were euthanized 3 or 6 weeks later. Both the right and left hindlimbs of each of the four rats sacrificed for histology were used to acquire histological sections. Hematoxylin and Eosin were used to stain ten slides per sample, which contained three specimens per slide (H&E). Collagen grade, angiogenesis degree, and cartilage induction were assessed using our new histological scoring system, which evaluates these three factors. Angiogenesis was assessed on a scale of 0–2, whereas collagen orientation and cartilage induction were graded on a scale of 0–3. The lower the score, the better the histology results.

There were three impartial, blinded observers (JD, DG and LW) who assessed each slide. Students were graded on the basis of their ability to see clearly. A minimum of ten sections were used to grade each specimen. Grading was done in the area between the suture placements, which was close to the site of the transection. For observation and grading, an area of 3 mm2 was usual. Using sections stained with H&E and Masson trichrome, grading was performed at 100 and 200. Sections stained with Sirius red and viewed under polarized light were also used to examine collagen orientation. The overall histology score for each rat was calculated by averaging the grades given to each specimen. Its ultimate tensile strength ranged from 0 to 8, with lower numbers indicating the best results. The test results were then compared among the therapy groups.

The tensile grips of an EnduraTec ELF 2100 were used to assess the mechanical behavior of eight rats in each treatment group (Rashid, 2017). As a power study demonstrated, eight samples were needed for the four groups to obtain an accuracy level of 0.05. An 80 percent power to detect hypothesis differences at the 0.05 level was found utilizing a two-tailed test with a sample size of eight subjects per group. Cold-frozen dissected leg parts from rats have been used in the study. Samples were thawed to 4°C

and drawn in uniaxial strain to failure at each time point (Delgado Caceres, et al., 2021). The load was documented to 0.005 N with an accuracy of 2Hz by using an open-loop control with a 0.025 mm/s displacement rate (Rashid & Basusta, 2021). Data on load and displacement were used to build time-independent load-displacement curves. Each sample's ultimate tensile strength (the maximum force supported by the sample normalized to the cross-sectional area) was determined.. Measurements of the length of the major and minor axes of the tendon were used to calculate the cross-sectional area. In order to determine the efficacy of treatment, two-way ANOVA tests were conducted.

A scatter plot analysis in Microsoft® Excel was used to calculate the coefficients of determination (R2). The correlation coefficient was squared to get this number. The contralateral, unoperated tendon was used as a control in the comparison of biomechanical data between the experimental and control groups. An appropriate UTL (UTL) % was calculated for the experimental and surgically repaired groups by using the control tendon's tensile load biomechanics. Using the UTL function, histology scores were plotted against the coefficient of determination (R2) for each treatment procedure. An optimal percentage of optimal UTL was determined by plotting each UTL value as the y-coordinate on the graph. UTL data was also correlated with each specific histological parameter. On the basis of their close association, we were able to determine the histological intervals at which different biomechanical scores became apparent. The Grande Histological Biomechanical Correlation Score (GHBCS) was determined as a result of this. In this way, the ultimate tensile strength of a non-ruptured tendon can be calculated as a percentage of its non-ruptured biomechanical score.

III. RESULTS

It was found that postoperative week 3 collagen orientation was improved in sutures treated with GDF-5 at low dose (24 ng/cm) and high dose (556 ng/cm), compared to controls. Results at 6 weeks were similar regardless of therapy [8]. Week 3 of suture treatment revealed isolated hyaline cartilage in tendons, regardless of the procedure used. De novo cartilage creation was more prevalent six weeks after surgery. The majority of this chondrogenesis took place in the areas where sutures were placed. Compared to untreated tendons, treated tendons showed more neovascularization (Table 1). The restored tendons were shown to be weaker than the contralateral, unoperated tendons in terms of ultimate tensile load (P .001). However, the UTL of the growth factor-treated sutures differed significantly from the control group (P .01). The experimental tendons resembled the unoperated tendons more, but they still differed significantly (P .02) from each other. Three-week tendons have half the UTL biomechanics of six-week tendons.

Table 1: Descriptive Test

	UTL	Histology	Caetilage	Angiogensis	Collagen
0	0.29±0.075	1.898	0.061±0.69	0.311±0.046	0.0576±0.062
24	0.61±0.38	1.354	0.211±0.56	0.454±0.44	0.84±0.28
55	0.49±0.33	2.112	0.76±0.049	0.69±0.067	0.61±0.056

Histological Grade

Reparative histology (a low histology score) and the experimental groups' ultimate tensile strength ratios were shown to be directly related in each suture strategy. Histological scores greater than 2.2 are associated with ultimate tensile stresses that are less than 30% of those of an unoperated control specimen. Test results less than 1.6 show that tensile loads will be more than twice that of an unoperated control, indicating that repair conditions must be improved (Table 2). Sections of disordered collagen, little to no angiogenesis, and moderate to extensive cartilage production are seen at histological scores greater than 2.2 Combined, these characteristics are associated with a lower than 30 percent rate of UTL biomechanics. There is just a slight infiltration of new blood vessels and no chondrogenesis seen in tissue with a histology score of less than 1.6. Tendons with such features have a higher biomechanical strength. More than half the strength of unoperated controls can be found in one tendon. Correlations between the healed tendon's histology qualities and its biomechanical traits were found to be 0.91. There was also a correlation coefficient of 0.89 between ultimate tensile strength and the orientation of collagen, angiogenesis, and cartilage production .

Table 2: Correlation Scores

UTL	Histologic
>1.9	<20
2.0-2.4	20-29.5
1.8-1.9	30.5-32
1.6-1.7	32-33.5
1.5-1.6	33.5-35
<1.5	>40

IV. DISCUSSION

An Achilles tendon model from a rat was used as a basis for developing a method for assessing postoperative biomechanical strength. The Grande Histological Biomechanical Correlation Score was used to accomplish this. There was no discernible difference between the experimental and control groups in the six-week study, despite enhanced tendon healing observed in the 3-week study. Data from all rats, regardless of the changes between the three-week and six-week investigations. When we looked at 6-week experimental and control groups in our previous study, we found that both groups had similar histological properties and similar biomechanical properties (Linderman, et al., 2018). These results corroborated the findings of the three-week examination. In other words, histology and biomechanics share a significant link. As more biological investigations are carried out in animal models, this approach will become even more valuable in the future. There is still some subjectiveness in the histological grading scale, which was developed in part to reduce the subjectiveness that existed in previous grading systems. However, we were able to demonstrate a link between histology and biomechanics by combining the findings of three different experts. All of these people had a background in histology, therefore the scale could be used correctly and objectively by all of them. Histology and biomechanics had the best correlation using this approach. Since histology and biomechanics are linked, researchers can get a good idea of biomechanical performance without having to undertake the tests themselves.

Each parameter's average histology score and ultimate tensile strength were calculated. The more closely the two factors correlate, the more expensive the undertaking is. As a result, we recommend that the histological sections be graded by three independent observers. We used the coefficient of determination to look at the connection between histology and UTL (R2). An R2 score of 1.0 indicates that the regression line fully fits the data, and it is a statistical measure of how well it approximates real data points. A great deal of care must be taken when using the coefficient of determination in correlation studies. Despite its name, correlation does not prove the existence of a causal link. There is no guarantee that when one of these two variables changes, the other will likewise change, despite the excellent correlation found in this study between UTL and histological grade (R2=0.91). However, it means that it is quite probable. To reiterate, this applies to any attempts to demonstrate a connection between two variables and is not limited to the findings of this study. These tendon healing processes are part of the body's normal response to injury and take place even in the absence of elevated levels of growth factor. Some may argue that a histology score of 2.376 (control suture group) is not indicative of a bad biomechanical rating, given that a score of 8 is the worst conceivable grade. To get scores considerably higher than 2.376, however, it appears implausible given the body's inherent propensity to mend and the data from the 24 controls.

Each histology property was associated with a specific correlation coefficient for the ultimate tensile load. Collagen histology grading alone was not sufficient to determine UTL, as evidenced by the coefficient of determination of 0.59 when comparing collagen with UTL. Meaning that there was no clear link between the reported collagen properties and any significant differences in UTL levels. Poor biomechanics and a poorly repaired tendon are both associated with disorganized collagen fibrils, according to research (Ruan, et al., 2021). Further research has shown that the parallel arrangement of collagen fibers is a significant contributor to collagen's tensile strength (Bulut & Rashid, 2020). This is not something we contest because it correctly highlights the role collagen plays in tendon recovery. While collagen properties are important, we do not feel that they are the only thing that must be taken into account in order to accurately determine tendon healing using UTL. As a result, our histological investigation includes both angiogenesis and chondrogenesis.

The second criteria was vascular infiltration, because a better blood supply is necessary for tendon recovery when it is wounded. The tenosynovium's cells can be disrupted by tendon injury, which should lead to angiogenesis (Abdou, et al., 2019). Repair is hampered by a lack of nutrients and growth factors delivered to the healing region by the bloodstream. In fact, blood-derived mesenchymal cells and fibroblasts are required for the initial repair of a tendon (Lu, et al., 2019). Despite this, we found no link between UTL and angiogenesis. Because they have an effect on tendon healing as well, histological qualities must also be considered while evaluating this criterion.

In damaged tendons, cartilage-inducing genes have been demonstrated to be upregulated. Tendons from rats with tendinopathy caused by overuse regimens have been discovered to have a cartilage phenotype (Rashid, et al., 2018). Achilles tendon cartilage formation in rats has been documented in other research (Kokubu, et al., 2020). Using cartilage as an indicator of an inferior repair process and worse biomechanics, we created our model. Our research showed that UTL and subsequent tendon repair are harmed by the presence of cartilage. (R2 = 0.89) between chondrogenesis histological grades and UTL (Misir, et al., 2020); the lower the level of cartilage production, the higher UTL. For specific histological markers, only cartilage development was found to have a significant link with the

UTL. Angiogenesis and collagen creation must also be taken into consideration when looking at the association between tendon injury and chondrogenesis, even if these results confirm prior studies.

V. CONCLUSION

Using the total histological grade, which integrates scores from each of the three factors, the strongest coefficient of correlation may be found. Because no single measure correlates with biomechanics as strongly as the whole histological score, this provides more evidence for its usefulness. Whereas grading tendon restoration, prior studies have focused on collagen alone, when in fact, two additional factors (as stated above) can provide a more accurate assessment of the repairing tendon's status. When measuring tendon restoration, a scoring system that allows for a quantitative evaluation of biomechanical strength as a function of histological features is essential. A unique histological scoring scale and the biomechanical features of tendon restoration in a rat model were shown to have a good association in this model.

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Low Inrıdıum-Doped TiO_2 Nanostructure for Promısıng Photocatalyst ın Hexane Treatment

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Abstract *— M-doped TiO_2 (with M: noble metal) photocatalysts are being extensively applied for volatile organic compounds (VOCs) treatment because of their wide range of gaseous VOCs treating ability and their lower cost in comparison to other methods. However, the efficiency in removing volatile gaseous VOCs of M-doped TiO_2 photocatalysts is relatively low due to the insufficient decrease of the band gap after doping (E_g < 3.0 eV), relatively low surface area (< 100 m^2/g) for using sol-gel method in combination with thermal treating at high temperature (>500 °C). In this work, we have solved current issues of TiO_2 photocatalysts by synthesizing nano-scaled advanced-structured Ir-doped TiO_2 materials in photocatalyst application for n-hexane decomposition, which has not been studied lately. The Ir-doped TiO_2 photocatalyst is synthesized by one-stage hydrothermal method without using any surfactant or heating process after reactions. We found that the efficiency in n-hexane treatment of Ir-doped TiO_2 photocatalyst with different ratios is relatively higher than other previous studies. It can be explained by the synthesis process of Ir-doped TiO_2 material optimizing nano-scaled particles (10-15mm), large surface area (170 m^2/g) and good crystallinity with the combination of anatase phase and rutile phase. Specially, Ir doping reduces the band gap of Ir-doped TiO_2 material from 2.5 to 2.7 eV, compared to 3.2eV of undoped -TiO_2 material's band gap, depending on the doping ratio in which the function of doped Ir metal is affecting the*

activity in photoreaction of TiO_2 by electrons or holes "traping" mechanism changing the electron/hole combination rate, hence enhancing the n-hexane treating efficiency.

I. INTRODUCTION

Recently, photocatalysts are becoming promisingly alternative material for air treatment due to some advantages such as the ability to deal with wide range of pollutants, high efficiency, simple operation and maintenance, reducing energy needed for degradation of volatile organic compounds (VOCs), therefore they can improve the quality of the air [1-3]. However, the application of TiO_2 photocatalyst material is still limited because of the short range of wavelength affected ($\lambda < 400nm$) and the low adsorption capacity of solar and indoor raditions (less than 5%) because the band gap of TiO_2 has relatively high energy (anatase TiO_2, ~3.2 eV) [5-6]. To solve this issue, some methods of enhacing efficiency of TiO_2 photocatalyst have been studied. In those methods, the method of doping metals into TiO_2 lattice structure is considered as the sufficient approach to narrow the band gap [7-8] and decline the rate of recombination of electrons and holes, thus improve the photocatalytical efficiency of TiO_2 in visible light region [9]. In 2011, *Ming Jin et al.* [12] synthesized the W-doped TiO_2 photocatalyst by electrospining method and heating at 550^0C to decompose acetone. The result showed that W-doped TiO_2 photocatalyst has the high capacity of acetone oxidation. It can be explained by the reduction mechanism from W^{6+} to W^{5+}, in which W^{6+} donates the photogenic electrons to prevent the recombination of electron-hole pair. However, by experimenting different of W/Ti ratios, from 2% to 8%, the authors concluded that with the increased proportion of W doped, the photocatalytic activity decreased. *M. Hinojosa-Reyes* et al. (2013) [13] used the perlite granules coated with In-doped TiO_2 photocatalyst to decompose ethylbenzene gas [13]. The In-doped TiO_2 materials, containing 1.0 and 5.0 wt% of In doped, are synthesized by sol-gel method from Titanium (IV) isopropoxide and Inidium (III) acetylacetonate precusors, then heated at $400\ ^\circ C$ in 4 hours. The products showed that 5.0 wt% In-doped TiO_2/perlite photocatalyst has the ehtylbenzene degradation efficiency of ~25% in 40 minutes, higher than the efficiencies of TiO_2 (P25) photocatalyst with ~15%. However, the result also showed that 5 wt% In-doped TiO_2 photocatalyst has the band gap of 3.32 eV, which is higher than the band gap of commercial TiO_2 (P25) photocatalyst (3.26 eV). This is also the limit of the In-doped TiO_2 photocatalyst in visible light region.

In 2014, *Siva Nagi ReddyInturi* et al. [14] also investigated a series of M-doped TiO_2 photocatalyst materials (M = V, Cr, Fe, Co, Mn, Mo, Ni, Cu, Y, Ce, and Zr) to decompose acetonitrile vapor. The M-doped TiO_2 photocatalyst material was synthesized by the method of Flame Spray Pyrolysis (FSP). Within the investigated M-doped TiO_2 photocatalysts, the Cr-doped TiO_2 photocatalysts presented outstanding activity with the energy bandgap, which reduced to 2.90 eV under visible irradiation. At the same time, M-doped samples of other metals do not have similar activity in the identical experimental condition. The superior activity of Cr-doped TiO_2 was explained by the migration of electrons from TiO_2 to the Cr component, leading to a strong Cr-O-Ti bond. After investigating M-doped activities under visible radiation, the author concluded that the photolysis activity of the Cr-doped TiO_2 sample performed 8 to 19 times higher than others, ranking then were Fe and V doped samples, and other metals had negligible activity, respectively. In 2015, Haibao Huang et al. [15] investigated a series of transition metals (Mn, Co, Cu, Ni, Fe) doping into the TiO_2 network to improve the benzene

decomposition under vacuum ultraviolet (VUV) irradiation. M-doped TiO_2 photocatalysts (M = Mn, Co, Cu, Ni, Fe) were synthesized by the sol-gel method and calcined at $550\ °C$ C for 4 hours. The particle size range of the resulting photocatalyst material has about 10-40 nm, and the specific surface area is < 50 m^2/g. The results show that the Mn-doped TiO_2 material has the highest benzene decomposition efficiency (~58.0%) and ozone in the range of investigated materials. However, previous work has only focused on the treatment of acetone [10, 12], ethylbenzene [13], xylene [11]; few researchers have addressed the problems of the n-hexane organic compounds treatment. The treatment efficiency of n-hexane treated by M-doped TiO_2 photocatalyst was shallow because the M-doped TiO_2 photocatalyst materials still give bandgap energy > 3.0 eV [16, 17]. In addition, the sol-gel method combined with the post-reaction calcination stage were often used to synthesize M-doped TiO_2 photocatalysts, resulting in large particle size and low specific surface area (<100 m^2/g) [15, 16, 18] should lead to low decomposition efficiency of volatile organic compounds (VOCs). LexuanZhong et al., 2013 [4] studied how to coat TiO_2 particles on glass fibers by coating the support; the results were obtained TiO_2 particles with particle size about 3.5 nm and decomposed n-hexane with n-hexane concentration: 500 ppb, relative humidity: 40-60%. The resulting yield was 25%.

In this study, we want to solve the above problems of M-doped TiO_2 photocatalyst by synthesizing the new nanostructure of Ir-doped TiO_2 with low and different Iridium concentrations which is applied as photocatalyst for n-hexane decomposing which has not been studied before [19-21]. By doping metallic Ir into TiO_2 structure, the band gap can be reduced by more than 25% compared to the band gap of undoped-TiO_2 photocatalysts [22] due to the approximation in the radius of Ir^{4+} ion (r_{Ir} = 0.625 Å) and Ti^{4+} ion (r_{Ti} = 0.605 Å) increases the efficiency in doping Ir compared to doping other elements, thus it reduces the band gap of TiO_2 significantly. Furthermore, Iridium has some unique properties such as anti-sintering, lower surface coverage, charge spray properties, and non-toxicity, which cannot be found in other metals [21, 23-25, 26] so that it could be improved the n-hexane decomposition efficiency.

II. EXPERIMENTS

2.1 Synthesis of Ir-doped TiO_2 Photocatalyst

The Ir-doped TiO_2 photocatalyst is synthesized by single-stage hydrothermal method at low-temperature without using of any surfactant or stabilizers or post-reaction heat treatment. First, a quantity of salt (0.0035g; 0.0070g; 0.0105g, respectively correspond to 0.5%, 1.0% and 1.5% of Ir) $IrCl_3.xH_2O$ was dissolved in 50 ml of distilled water. Because TiCl4 is easily hydrolyzed at room temperature, so it is necessary to adjust pH = 1.5 to limit the hydrolysis of TiCl4. Using micropipet add 220µL $TiCl_4$ into solution. The solution sample was transferred to the autoclave at 210 °C and in 8 hours. After the end of the reaction time, the solution was allowed to cool naturally in air at room temperature, then centrifuged, filtered for solids and washed several times with distilled water until the pH reached neutral. Finally, the precipitate was dried at 80oC for 8 hours to obtain Ir-doped TiO_2 photocatalyst.

2.2 Material Characterization

The crystal structure analysis of the obtained samples was analyzed using a Bruker D8 Advance X-ray diffractometer using Cu K_α radiation (λ = 1.540598 nm) in the 2θ range of $10 - 80\ °$ at a scanning rate (2θ) of 5 min^{-1}. The morphologies of the pure TiO_2 and Ir-doped TiO_2 samples were characterized by field emission scanning electron microscopy (SEM) on a HitachiS-4800, transmission electron microscopy (TEM) on a JEM 1400 operated at 100 kV and field-emission high-resolution transmission electron microscopy

(HRTEM) on a TALOS F200x with an acceleration voltage of 200 kV equipped with an energy-dispersive X-ray spectroscopic analysis (EDS) system. X-ray fluorescence (XRF) measurement was performed on ARL ADVANT'X (Thermo) at an accelerating voltage of 30 kV to record the elemental composition in the as-obtained nanomaterials. In the BET method, N_2 adsorption/desorption isotherms were performed on NOVA 1000e at 77K to measure the surface area and pore size of the TixIr1-xO2 catalysts. Before BET measurements, the specimens were degassed/dried at $250\ °C$ for 3 hours to eliminate water molecules adsorbed in the meso/micropores of the catalyst support. Measurements of the UV-visible diffuse reflectance spectra (DRS) of samples were carried out on a UV-Vis spectrophotometer (JASCO-V670) at room temperature in the range of 350−800 nm.

2.3 N-hexane treatment System

n-hexane (C_6H_{12}) oxidation reactions occuring on the new nano-scaled Ir-doped TiO_2 photocatalyst are performed in a specifically built system. The concentration of gas n-hexane is measured before and after being blown through the photocatalyst for analysing photocatalytic properties of the material.

The experimental system is shown in Figuer 1 includes:

- A P1 pump blowing air into the system
- A glassy column containing silicagel material, which is kept by two rubber caps and glassy cotton to remove humidity out of inlet air.
- A glassy column containing activated carbon to clean and remove the residual humidity.
- A F1 flowmeter to control the air flow rate.
- A 5mm – diameter glassy tube containing a drop of n-hexane in distilled water)
- An alcohol burner to evaporate a drop of sample.
- A four-way valve to control the direction of gas flow.
- A 3L air bag to stabilize the concentration of gaseous sample before introduced through the photocatalyst layer.

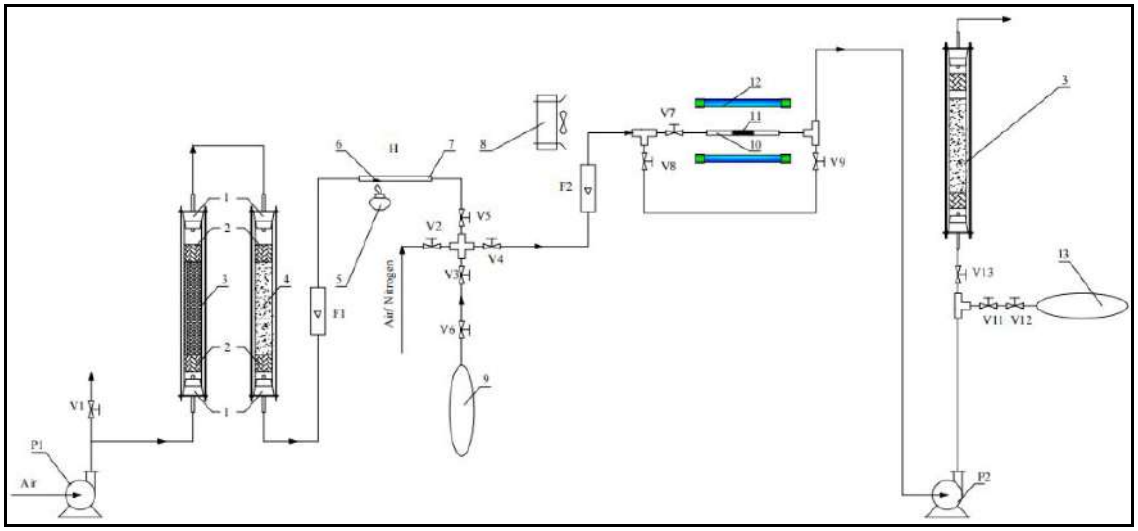
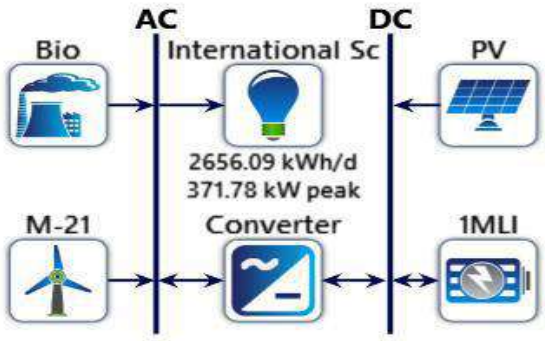


Fig.1: Schematic diagram of n-hexane treatment using Ir-doped TiO_2 photocatalyst system in laboratory.

1. Rubber cap; 2. Glassy cotton; 3. Silicagel; 4. Activated carbon; 5. Alcohol burner; 6. Sample drop; 7. Glassy tube; 8. Cooling fan; 9. Bag containing inlet gas; 10. Reaction tube; 11. Photocatalyst; 12. UV light; 13. Bag containing outlet gas.P1: Pumping air in; P2: Withdrawing air out; F1: Flow meter for inlet gas; F2: Flow meter for gas passing through photocatalyst.

2.4 Treatment process of n-hexane

The tightness of the system was checked by using soap on the joints and using a pump to blow air through the system; if soap bubbles did not present, then the system was utterly sealed. System tightness testing was conducted at the beginning of the test sessions. During the testing sessions, the tightness test would be re-run and corrected whether the following signs were observed: the joint was not sealed, the flowmeters F1 and F2 were not working or working weaker, the tension of the airbag was not adequate after a certain period of air collection.



Experiment according to the following steps: (i) Fasten the inlet sample airbag to the connection position with valve V3, open valve V6 (airbag valve), set flowmeter F1 to 1 liter/min, lock all valves, stuff glass wool, and drops of a sample (consisting of 0.02 mL n-hexane and V mL distilled water) into the sample dropper tube, light the alcohol burner, and heat the glass tube containing the droplet over the flame for 1 min; (ii) Open valve V5 and V3, then turn on pump P1 and start a timer simultaneously, collect air within 3 minutes to fill the bag, turn off valve V6 of the airbag, turn off pump and alcohol burner, lock remaining valves; (iii) Stuff 0.1g of the synthesized catalyst material into the glass tube, divide the amount of catalyst into three equal segments alternating with glass wool samples so that the catalyst is evenly distributed on the tube. Turn on the radiator fan, UV lamp, let the UV lamp works for 10 minutes before operating to ensure that the emitted radiation is stable, fasten the airbag to the connection position with valve V11, open valve V12 of the airbag; (iv) Turn on pump P2, open valve V6, and start pressing the timer simultaneously; collect investigated air for the time t (minutes) with the set flow until the airbag reaches the appropriate tension. Lock valve V12, V11, remove the gas sample's airbag, turn off pump P2, and turn off the UV lamp; (v) After the gas collection is complete, clean the system: glass tubes containing sample drops and catalyst column; lock valve V3, open valve V2, and V13 to blow air into the system, then close all valves. Hence, prepare for the next experiment and (vi) After being labeled with the symbol, the airbag containing the sample is placed in the tank and transferred to the analysis company to conduct gas chromatographic analysis for determining the concentration of n-hexane.

III. RESULTS AND DISCUSSION

3.1 Characterization of It-doped TiO_2 Photocatalyst with different ratio of Ir doping in TiO_2

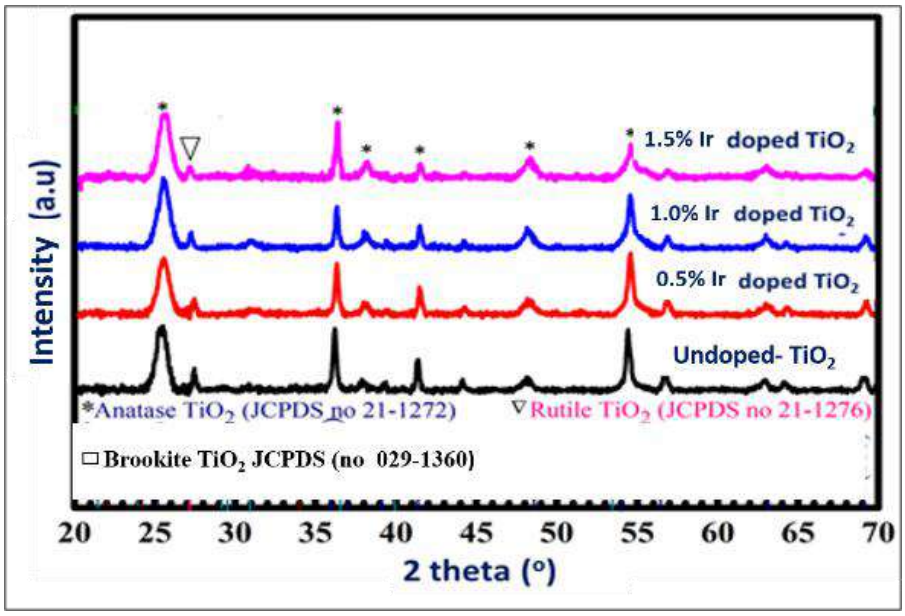


Fig.3: X-ray diffraction patterns of Ir-doped TiO_2 photocatalysts with different Ir-doped ratios of 0.5%, 1.0%, 1.5% respectively

Figure 3 shows XRD measurement of the photocatalysts with different Ir-doped ratios of 0.5%, 1.0%, 1.5%. The result shows the diffraction peaks of pure undoped-TiO_2 are at 2θ positions of $25°, 36°, 41°, 48°, 55°, 57°, 63°, 69°$ respectively corresponding to (101), (103), (210), (200), (105), (201) faces, in which the (204) and (116) faces might relate to anatase TiO_2 phase tetrahedral. The peaks of IrO_2 are not obtained, thus it might show that Iridium was successfully doped into TiO_2 structure. The intensive peaks at 2θ positions of $25°, 36°, 55°$ indicate the crystallographic orientation of anatase phase, besides that, the peak at 2θ position of $27°$ corresponds to the crystallographic orientation of rutile phase. The intensive peaks show that the formation of anatase phase is more preferred than formation of rutile phase.

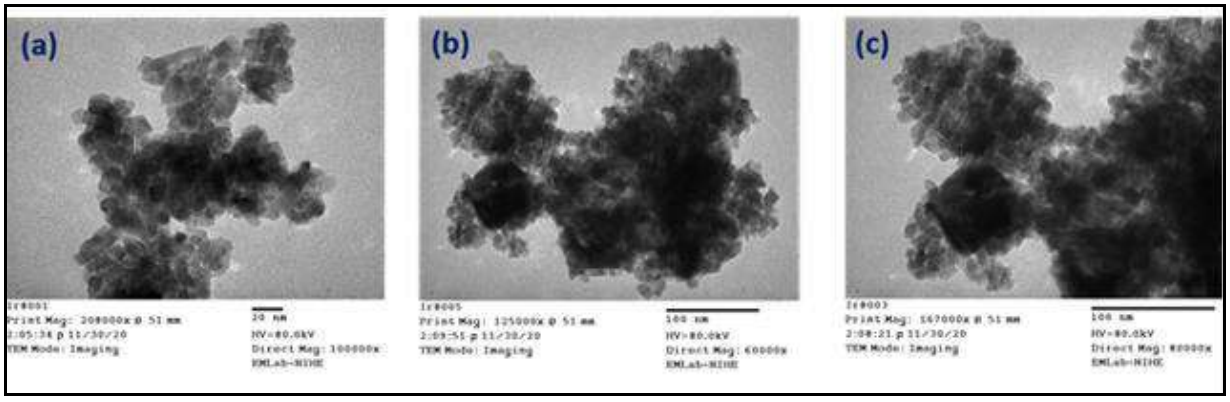


Fig.4: TEM images of Ir-doped TiO_2 photocatalysts with different Ir-doped ratios of (a) 0.5%; (b) 1.0%; (c) 1.5%

The formations of Ir-doped TiO_2 nanoparticle samples shown in Figure 4 indicate that the synthesized photocatalytic material mainly have cubic structure and average size of particles is from 10 to 15 nm. The nanorod particles are corresponding to the formation rutile phase, while the nanocube particles are related to anatase phase. The existence of two particle structures is related to two phases, anatase and rutile. The predominace nanocube particles (anatase phase) is resistent with the XRD result. In addition, the particles are uniformly distributed although the clusters still exist. It is found that from other previously studied M-doped TiO_2 photocatalysts, which are usually synthesized by sol-gel method combined with heat treatment at high temperature ($>500°C$) forming large particles, the Ir-doped TiO_2 photocatalyst is synthesized by hydrothermal method in this work resulting in smaller particles.

Table 1. XRF analysing results of Ir-doped TiO_2 photocatalysts with Ir-doped ratios of 0.5%; 1.0%; 1.5% respectively

No.	Sample	Ir proportion in sample (XRF measurement)
1	0. 5% Ir doped TiO_2	0.62%
2	1.0% Ir doped TiO_2	1.15%
3	1.5% Ir doped TiO_2	1.80%

Table 1 shows the elemental composition of Ti and Ir gives a measure of the doping denaturation ratio by XRF method is close to the calculation theory and at an acceptable level, which shows that the elemental composition of the catalyst can be controlled relatively easily through modification of the initial precursors ($IrCl_3.xH_2O$ và $TiCl_4$). However, the actual ratio tends to be positively error, which can be explained by the fact that $TiCl_4$ is easily hydrolysed when exposed to the external environment, so the loss of TiO_2 may be due to the addition of $TiCl_4$ into the solution. The solution has a small amount of $TiCl_4$ hydrolyzed.

The surface area of the synthesized catalyst samples was analyzed by N_2 adsorption and desorption with Ir-doped TiO_2 catalyst samples, which have the proportions of 0.5%; 1.0%; 1.5% were presented in Table 2.

Table 2. BET analysis results

No	Sample	Specific surface area (m^2/g)	Pore side (nm)
1	0. 5% Ir doped TiO2	156	2,2
2	1.0% Ir doped TiO2	164	2,7
3	1.5% Ir doped TiO2	170	3,1

The surface area of the synthesized catalyst samples was investigated by N_2 adsorption and desorption. The results showed that the Ir-doped TiO2 nano photocatalyst material at the proportion of 1.5% Iridium had the highest specific surface area of 170 m^2/g. This outcome was consistent with the TEM analysis results because the small cubic particle size makes the material's specific surface area higher.

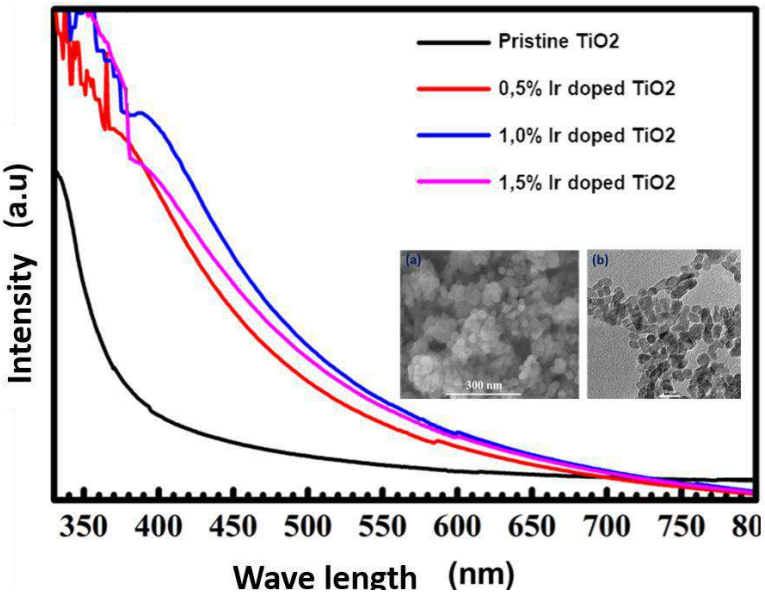


Fig.6. UV-VIS analysis results of 0.5%, 1.0% and 1.5% Ir-doped TiO2 catalyst

In Figure 6, a significant difference could be observed in the absorption of the undoped TiO_2 and Ir-doped TiO_2 photocatalysts having different Ir concentrations. In the wavelength region less than 400 nm, absorption of undoped TiO_2 was observed because its bandgap was related to the bandgap excitation of anatase TiO_2 corresponding to this region-to-region transition. On the other hand, the Ir-doped TiO_2 samples having different Ir concentrations showed an apparent absorption in the longer wavelength region, and the bandgap energy decreased from 3.2 (eV) to 2,5 (eV) in the visible irradiation

3.2 The efficiencty of n-hexane treatment by Ir-doped TiO_2 photocatalyst with different Ir-doped ratio of 0.5%; 1.0%; 1.5%

3.2.1 Effect of Ir-doped ratios on n-hexane decomposing efficiency

Table 3. The experimental parameters in analysing the effect of Ir-doped ratios to n-hexane decomposing efficiency

No	Iridium proportion *(%)*	n-hexan volume *(mL)*	H_2O volume *(mL)*	Measure humidity *(%)*	Airflow rate *(mL/min)*	Time for obtaining gas *(min)*
1	0.5	0.02	0.11	72	200	15.80
2	1.0				200	15.28
3	1.5				200	15.23

Table 4. Gas chromatography results of determining n-hexane concentrations, corresponding with 0.5%; 1.0%; 1.5% Ir-doped TiO_2 samples

No	Iridium proportion (%)	Concentrations of n-hexan before reactions C_o (mg/m^3)	Concentrations of n-hexan after reactions C_m (mg/m^3)	Decomposing efficiency H (%)
1	0.5	10591	4534	57.18
2	1.0		4616	56.42
3	1.5		4799	54.68

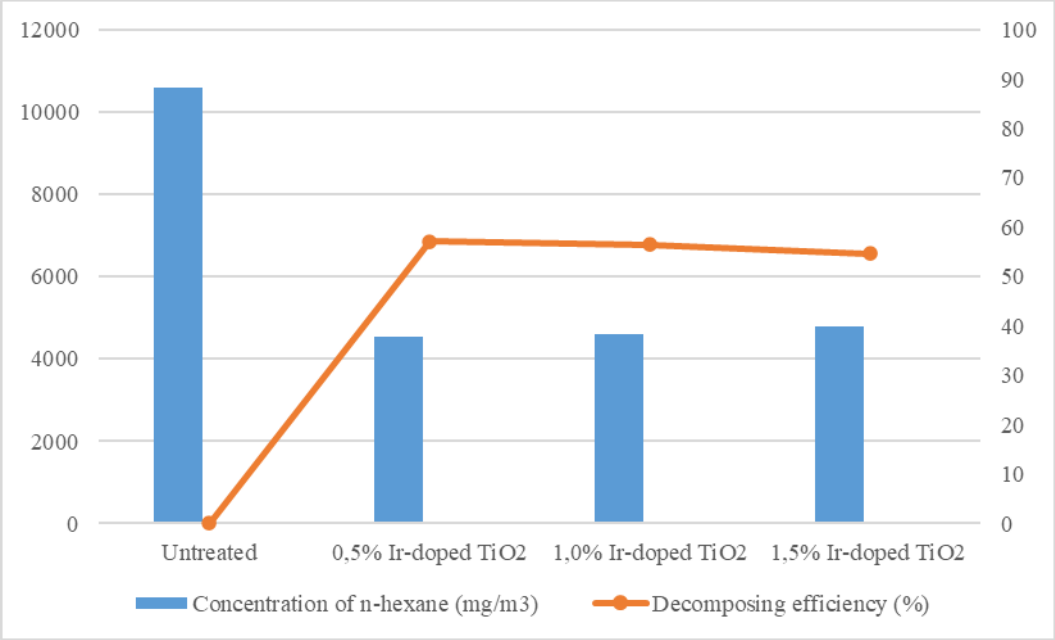


Fig.7. Effect of Ir-doped ratios on n-hexane decomposing efficiency

Table 3 shows the experimental parameters in analysing the effect of Ir-doped ratios to n-hexane decomposing efficiency. Table 4 and the Figure 7 show the concentrations of n-hexane in gaseous sample before and after being treated with Ir-doped TiO_2 photocatalyst with different Ir-doped ratios. The reactions are taken place with the conditions of n-hexane and H_2O sample drops of 0.02mL and 0.11mL respectively (corresponding with the measured humidity of 72%), the 200mL/min airflow rate and 15min residence time to fulfill TEDLAR BAG 3L airbag. After finishing the experiments, with gas chromatography analysis, the n-hexane concentrations in 0.5%; 1.0%; 1.5% Ir-doped TiO_2 are 4534 4534 (mg/m^3), 4616 (mg/m^3) and 4799 (mg/m^3) respectively and the corresponding decomposing efficiencies are 57.18%, 56.42%, 54.68% respectively and the difference is not large. This result indicates that the Iridium proportion has negligible effect on n-hexane decomposing efficiency. For a saturated hydrocarbon and hardly decomposed compound like n-hexane, the obtained efficiencies of more than 50% are relatively

high. Different from treating, for the n-hexane, 0.5% Ir-doped TiO_2 sample has the higher decomposing efficiency than that of other samples (57.18%), therefore it is chosen to be the optimizing efficiency for the following analyses

3.2.2 Effect of airflow rate on n-hexane decomposing efficiency

Table 5: The experimental parameters in analysing the effect of airflow rate to n-hexane decomposing efficiency

No.	**Ir proportion** *(%)*	**Volume of n-hexan drop** *(mL)*	**Volume of H_2O drop** *(mL)*	**Measured humidity** *(%)*	**Airflow rate** *(mL/min)*	**Residence time** *(phút)*
1	0,5	0,02	0,11	72	125	24,12
2					200	15,28
3					350	8,75

Table 6: Gas chromatography results of determining n-hexane concentrations, corresponding with airflow rate of 125,200,350 (mL/min) respectively

No.	**Airflow rate** *G (mL/min)*	**n-hexane concentration before reactions** *C_o (mg/m^3)*	**n-hexane concentration after reactions** *C_m (mg/m^3)*	**Efficiency** *H (%)*
1	125	10591	4529	57.24
2	200		4534	57.18
3	350		4585	56.71

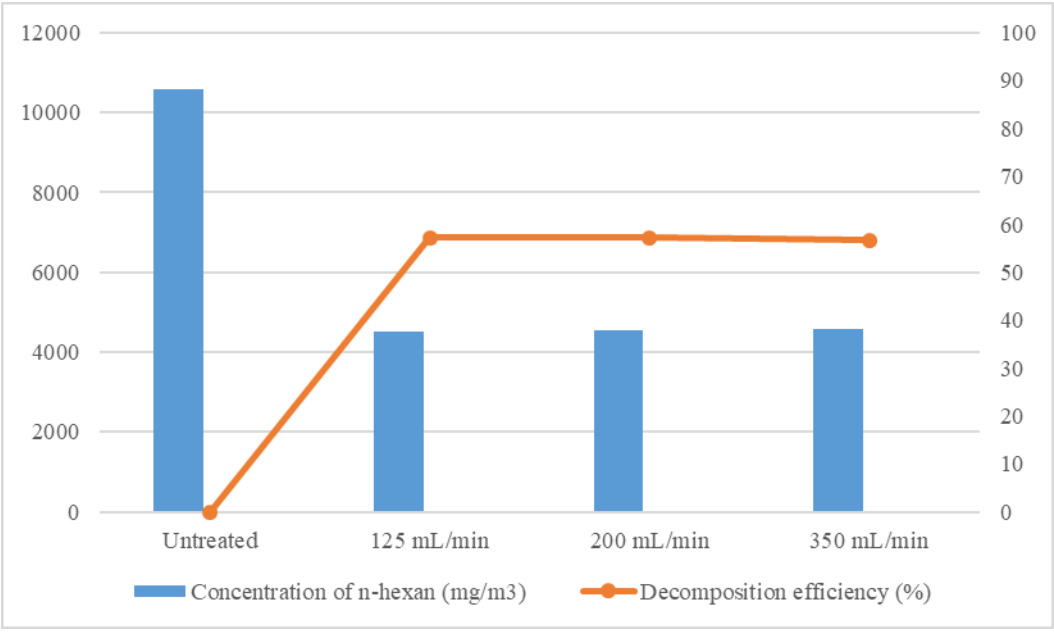


Fig. 8. Effect of airflow rate to n-hexane decomposing efficiency

Table 5 shows the experimental parameters in analysing the effect of Ir-doped ratios to n-hexane decomposing efficiency. Table 6 and the Figure 8 show the concentrations of n-hexane in gaseous sample before and after being treated with Ir-doped TiO_2 photocatalyst with different airflow rate of n-hexane. The results chromatographic analysis determined that the concentration of n-hexane was 4529 mg/m3; 4534 mg/m3; 4585 mg/m^3, from which the corresponding efficiency is 57.24%; 57.18%, and 56.71%. Besides, the selection of optimal conditions needs to combine the factors of time, resources and economy, so in this case, the loading rate is 350 mL/min (the gas collection time is 8, 5 min) is the optimal condition for n-hexane treatment.

3.3 Proposed Mechanism of n-hexane decomposing reaction of Ir-doped TiO_2 photocatalyst

The n-hexane decomposition efficiency of Ir doped-TiO2 materials was compared with previous studies as shown in Table 7. Compared with these results, these results are higher than previous studies on the n-hexane processing ability of Ir-doped TiO_2, showing that the n-hexane processing efficiency of Ir-doped TiO2 with different ratios gives the same efficiency. The higher processing efficiency than other studies was explained by the optimal Ir-doped TiO2 synthesis toward 10-15 nm nano-sized materials, large specific surface area, good crystalline structure, and miscibility of the anatase and rutile phases. Especially when denaturing TiO2 by Ir, the bandgap of Ir-doped TiO_2, depending on the denaturation ratio, decreased to 2.4-2.7 eV compared to 3.2eV of undoped TiO_2. The ionic role of the Ir metal affected the photoreactivity of TiO_2 catalyst by using an electron or hole "trapping" mechanism, thereby changing the recombination rate of e-/h+ (electrons/holes) despite the low bandgap of Ir-doped TiO2 photocatalysts. The above results show that the new Ir -doped TiO2 nanoscale photocatalyst material was a potential catalyst and could be widely applied to treat n-hexane.

Table 7: Results in analysing Ir-doped TiO_2 photocatalyst for n-hexane decomposing

STT	VOCs	Nanomater-ials	Synthetic method	Morphology	Conditions	Efficiency	Refs
1	n-Hexan	TiO_2 on carbon tubes	Method of covering on supporter	The size is about 3.1 nm. Large specific surface area (887.7 m^2/g)	Concentration of n-hexan: 500 ppb, relative humidity : 40-60%	50%	[28]
2	n-Hexan	TiO_2 on glass fibers	Method of covering on supporter	The size is 3,5 nm	n-hexan concentration: 500 ppb, relative humidity : 40-60%	25%	[28]
3	n-Hexan	Ir-doped TiO_2	hydrothermal	The size is about 10-15 nm	Concentration of n-hexan : 10590 ppm	57%	In this study

The mechanism of treating toxic compound n-hexane in the air using Ir-doped TiO_2 photocatalyst was proposed as follows:

Electron separation process:

Electron and hole pairs would be produced whenever the sample material was irradiated with an appropriate light source. These electrons and holes would be the main oxidizing agents, but they moved freely in the lattice and easily recombined with each other:

Ir-(TiO_2) $e_{cb}^- + h_{vb}^+$

Electron trap process:

In making Ir-doped TiO_2 materials, Ir3+ ions were converted into Ir^{4+} and replaced in positions of Ti4+ ions in the crystal lattice, causing defects in the lattice. From the obtained results, based on the electron trapping and displacement mechanism proposed by Choi et al., the role of Ir in the Ir-doped TiO_2 crystal lattice was described as follows:

Electrons trap center: $Ir^{4+} + e_{cb}^- \rightarrow Ir^{3+}$ (4.2)

Holes trap center: $Ir^{4+} + h_{vb}^+ \rightarrow Ir^{5+}$ (4.3)

Electron Transfer Reaction

After trapping the electron pairs, Ir metal would transfer electrons to the redox participating agents O2 and OH-:

$Ir^{5+} + OH^- \rightarrow OH\cdot$ (4.4)

$Ir^{3+} + O_2 \rightarrow O_2^{\bullet-}$ (4.5)

Due to the ability to trap both electrons and holes, the treatment efficiency of Ir-doped TiO2 catalyst was higher than other M-doped TiO2 catalysts. If only one of the two were trapped, the reaction efficiency would be low because the charges dissociate from the trap and move to the phase interface. The trap mechanism helped prevent the recombination of electrons and holes, increasing the lifetime of photogenerated electrons, thereby improving catalytic efficiency [27]. The water molecule adsorbed on the catalyst reacts with the hole, produces a hydroxyl radical, and oxidizes the organic compound. Photochemical reactions have been shown to depend on the production of hydroxy molecules [29], [30]. Oxygen is essential for photochemical reactions to occur. Usually, the rate of organic matter decomposition increases with oxygen concentration [31].

The treatment mechanism for organic compounds such as n-hexane by Iridium modified TiO2 photocatalyst could be summarized in Figure 9.

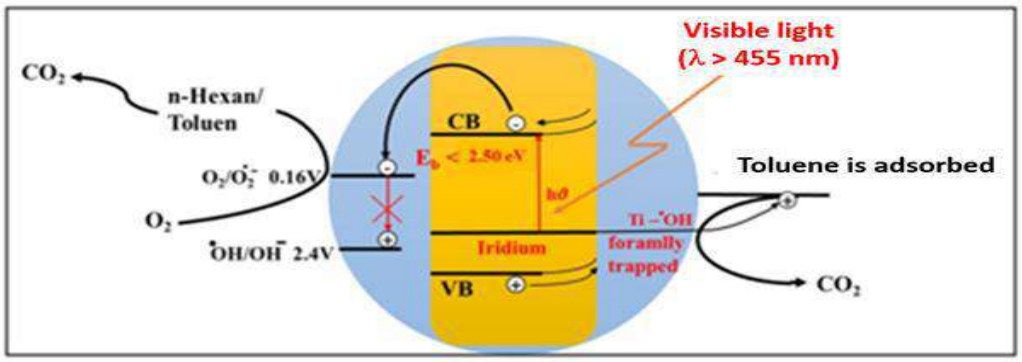


Fig.9. A proposed mechanism to degrade toxic organic compounds using Ir-doped TiO2 nano-sized photocatalyst materials.

IV. CONCLUSIONS

In this research, we have synthesized and analyzed the properties of TiO_2 photocatalyst materials modified at the low Ir concentration with different Ir doping concentration (0.5%, 1%, and 1.5%). We found that the Iridium-doped TiO_2 photocatalyst materials, which were formed by higher anatase phase at different Ir concentrations, had a cubic-shaped particle with an average size in the range of 10 to 15 nm; the 1.5% Iridium sample had reached the specific surface of 170 m2/g, and its lowest energy bandgap was 2.5 eV. The n-hexane toxic volatile organic compound treatment system was instated to evaluate the ability of decomposing n-hexane at different Ir concentrations and different n-hexane gas flows. Interestingly, it was fond that the decomposition efficiency by Ir doped-TiO_2 reached to 57% for n-hexane decomposition, which caould be explained by the ion of the modified metal Ir reducing the bandgap to 2.5 - 2.7 eV. It affected the photo-reactivity of TiO_2 by acting as an electron/hole "trap," thereby changing the rate of e-/h+ recombination (electron/ holes) toward improving the n-hexane decomposition efficiency. The above results showed that the new nanoscale photocatalyst material TiO_2 modified Iridium was a potential catalyst and could be widely applied in treating toxic VOCs such as toluene, benzene, acetone.

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Prevalence of Overweight, Obesity and Risk of Coronary Pathy in Jurisdictions of the State of Rondônia – Brazil

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Keywords ***—Overweight, obesity, coronary artery disease.***

Abstract— *The aim of this study was to investigate the prevalence of overweight, obesity and risk of coronary artery disease in judges in the State of Rondônia, Brazil. The sample consisted of 23 subjects in work activity in the court of justice of the state of Rondônia, aged from 28 to 45 years, who were divided into two groups of studies, according to age: Study Group 1 (GE-1), composed of 10 subjects from 28 to 36 years of age (Age: 33.6 ± 2.91; Body weight: 77.27 ± 9.85; Height: 170.1 ± 7.47); and b) Study Group 2 (GE-2) ¸composed of 13 subjects from 37 to 45 years of age (Age: 42.4 ± 2.53; Body weight: 80.76 ± 8.14; Height: 155.3 ± 16.40). To detect possible significant differences between the scores related to physical characteristics and the study variables of GE-1 and Ge-2, descriptive statistics and Student's "t" test were used for independent samples, respectively, seeking a significance of $p<0.05$. The scores of the analyzed variables did not present, when compared to each other, statistical differences at the level of $p<0.05$, with a $p=0.313$ for the EG-1 BMI and a $p=0.313$ for the risk of coronary artery disease in EG-2. = 0.236. It was also verified that the mean values of the aforementioned variable (27.4 kg/m ^{2} and 28.7 kg/m ^{2}for EG-1 and EG-2, respectively), they are classified as "overweight", and when quantified in percentage it*

was noticed that 20% of the subjects in EG-1 have a BMI classified as "normal", 60% have " overweight" and 20% are "obese", and in EG-2 individuals only 7.8% have a BMI classified as "normal", 61.5% are "overweight" and 30.7% are "obese" . Regarding the risk of coronary artery disease (CR), it appears that in EG-1 70% of the sample has it classified as "high", 10% classified as "low", 10% bandaged as "medium", and 10% as presents as "very high". IN GE-2, no element has the RC classified as "low", being 77% classified as "high", 11.5% as "medium", and 11.5% as "very high". These results indicate that the combination of different risk behaviors such as: smoking

I. INTRODUCTION

Although overweight and obesity were once misused and indistinctly used terms, nowadays they are known to have completely different meanings. This misunderstanding, for some time, certainly made it difficult to compare different studies on the subject, extremely impairing a more accurate diagnosis of these disorders, and thus compromising the exact assessment of their degree of incidence in the human body.

By overweight we mean the increase in total body weight that exceeds the standards associated with the individual's height, obesity being defined as a pathology characterized by the excessive accumulation of fat in a subject's body, which may negatively influence the quality of life of the individual. even and reduce its longevity, classified in two ways: a) essential fat, that necessary for organic functioning and that accumulates in the bone marrow, around the organs (heart, lungs, liver, spleen, kidneys, and intestines) , in the muscles and tissues rich in lipids distributed throughout the central nervous system; and b) reserve fat, that accumulated in the adipose tissue, occupying a greater volume under the subcutaneous surface, whose function is to protect the various internal organs from trauma, and it is important to highlight that,

For Dias et alli (2017), and also Nascimento et alli, (2020), obesity is a chronic-degenerative pathology of multifactorial character, which can be: genetic, hormonal, neurological, psychological, which when associated with inadequate nutrition and the reduction of significant motor activities in the subject's daily life, a phenomenon called sedentary lifestyle, contributes on a large scale to the emergence of degenerative diseases such as: arterial hypertension, stroke, dyslipidemia, diabetes, musculoskeletal disorders, osteoporosis, gastritis , several types of cancers, sleep disorders, depression, among others, leading the morbidity and mortality statistics to alarming rates.

As the fastest growing nutritional disorder in the world, overweight and obesity now affect more than two billion people, with an estimated 2.3 billion adults around the world being overweight in 2025, of which 700 millions of individuals with obesity, and becomes, due to the physiological consequences, cognitive and behavioral impairments, and even its deleterious effects on the affected individual's quality of life, one of the main public health problems worldwide, a fact confirmed by epidemiological and clinical (EICKEMBERG et alli, 2020; NASCIMENTO et alli, 2020).

Thus, the need for a prior and correct diagnosis of its levels seems clear, since, when the appropriate limits are exceeded, in addition to changing the morphological configuration, they can also negatively influence the subject's functional aspects. Considering this, Moreira et alli (2018) highlight the importance of the indicators of the Surveillance Survey of Risk and Protection Factors for Chronic Diseases by Telephone Survey, by the Brazilian Ministry of Health, according to which, in Brazil, the prevalence of obesity increased in alarming numbers with an increase of 67.8% in the last thirteen years, with the Brazilian Association for the Study of Obesity and Metabolic Syndrome - ABESO, estimating that in 2025 the world population of adults will reach approximately 2.3 million overweight people , and more than 700 million obese people (VIGITEL, 2018; MALVEIRA et alli, 2018; ABESO, 2019).

In this light, the Brazilian Federal Government recently reported a 72% increase in the incidence of obesity in the period between 2006 and 2019, from 11.8% to 20.3%, meaning that two out of ten Brazilians are obese, with the highest percentage affecting women (21%) and increasing with age: for young people aged 18 to 24 years, the increase is 87% and among adults aged 65 years it reaches the level of 20.9% (BRASIL, 2020).

Still in an epidemiological focus, the specialized literature considers that obesity is increasing both in rich countries and in developing countries, including in this aspect Brazil, where its prevalence has been a growing secular trend, since the rate of obesity in adults is 20.7% for women and 18.7% for men, and in relation to overweight the indicators are: 57.1% for men and 53.9%

for women. Such growth has been attributed to several processes, with the political, economic, social and cultural spheres representing part of the problem, and for this reason it is considered a multifactorial disease, in which all its dimensions must be addressed during its treatment (BARROSO etalli, 2017; MALVEIRA et alli, 2018; ABESO, 2019; BRAZIL, 2020).

This reality demands a high financial cost, and it is important to adopt governmental measures with the capacity to, through an integrated and synchronized look with the socio-cultural habits of the population, reduce the incidence of this comorbidity and improve the quality of life of affected people by the pathology on screen. Studies on the cost of obesity complement traditional epidemiological information by accounting for the high economic impact involved in treating the disease, which has been gradually increasing the sensitivity of managers, and the general public, to the adoption of preventive measures to combat it. disease on the agenda (DIAS et alli, 2017; ABESO, 2019; BRAZIL, 2020; OLIVO, 2020; EICKEMBERG et alli, 2020; ROCHA, et alli, 2021).

The control of this pathology is done using dietary, drug and even surgical forms of treatment, and in all of them, in parallel, it is necessary for the subject to permanently adopt healthy lifestyle habits, including whether in this aspect the regular practice of physical activity, for which it is important to have a detailed planning in relation to four basic aspects: intensity, duration, frequency and repetition, variables that must be properly planned and bandaged in a scientifically methodized work system regarding the prescription and control of training loads (ALMEIDA et alli, 2018; ALMEIDA et alli, 2020).

Given the above, it seems clear that there is a need to correctly identify the amount of body fat in the subject in order to better understand its consequences on the individual's organic functions, and the consequent adoption of therapeutic measures. In this aspect, there are several methods for its diagnosis, which are classified as follows: a) direct; b) indirect and c) doubly indirect, all of which have advantages and disadvantages that must be carefully analyzed (LANUTRI, 2019).

The direct method involves in its procedure the dissection and weighing of body tissues, not being viable for living beings. The indirect methods are validated as a result of the direct methods and estimate the body components based on chemical and physical assumptions, and, despite having excellent precision, they are invariably associated with high costs due to the technology required for their use. The doubly indirect methods are validated from the indirect methods, and estimate body composition through regression equations, with bioelectrical impedance and anthropometry being the most commonly used techniques (GUEDES, 2013; SOUZA, SARON & FILHO, 2018), with the latter, the anthropometric, through the calculation of the Body Mass Index (BMI), the one with the greatest practical applicability as it does not require great material sophistication in its execution, and presents scientific reliability, economic feasibility, simplicity of use, in addition to lesser cultural restrictions. For this reason, it was the procedure adopted in this investigation, since its results, despite being less rigorous, produce estimation errors at acceptable levels by the academic community.

It is known that overweight is among the top five attributable causes of premature death, accounting for approximately 10% of deaths that occur annually worldwide, and that, when identified after the second half of life, its effects are progressively deleterious and rapidly stimulate the emergence of various comorbidities (GBD, 2019; NELSON et alli, 2007). This fact constitutes a global public health problem, with the specialized literature investigating the incidence of body fat levels in different social groups for decades, especially in relation to gender, ethnicity, age, physical fitness (MATSUDO, FRANÇA & MONTGOMERY, 1989; GUEDES & GUEDES, 1996; BÖHME & KISS, 1997; LOPES & PIRES NETO, 1997; GLANER & PIRES NETO, 1998; GUEDES, 2002; KRUG & BRAZ, 2002; MALVEIRA et alli, 2018; ROSSI, 2019; LIMA et al, 2020; DAMASCENO et alli, 2020; BIRTH et alli, 2020; OLIVO, 2020; ROCHA et al, 2021; GUEDES & MELLO, 2021; GUEDES & SILVA, 2021a; GUEDES & SILVA, 2021b).

Such researches, without exception, indicate as being of paramount importance the need for an early diagnosis of excess weight, and in the most heterogeneous social segments, since, in addition to helping to detect groups that are more vulnerable to these pathologies, it also enables the carrying out prophylactic interventions in relation to obesity-related comorbidities, and, if these are already present, anticipating treatment to improve the quality of life of affected individuals.

Under this focus, it is observed that the labor activities of servers of the judiciary, especially magistrates, impose on them, due to the specificity of their own routines, a daily behavior of low motor skills during the development of labor activities. That is, admitting the excessively passive behavior during the development of their routine work activities, a fact that almost always extends to their other daily motor achievements, it can be assumed that these, the magistrates, have markedly a

decisive contributor to greater susceptibility the acquisition of excess weight, which, as previously shown, can have negative functional consequences for the individual's body. Thus, in order to broaden the perspectives of discussion on this topic.

II. METHODOLOGICAL PROCEDURES

The population of this study consisted of male magistrates working at the Court of Justice of the State of Rondônia. Initially, a first personal contact was made with those interested in participating in this study, voluntarily, to explain to them the relevance of the research and its methodological details, as well as requesting them to sign a free and informed consent form, authorizing the publication of the information obtained. The sample consisted of 23 subjects aged between 28 and 45 years, who, according to age, were divided into two study groups: Study Group 1 (SG-1), consisting of 10 subjects aged 28 to 36 years deity; and b) Study Group 2 (SG-2) , composed of 13 subjects from 37 to 45 years of age.

2.1. Study variables, equipment and measurement standardization

In this study, the anthropometric parameters were initially measured: a) Total Body Weight (TCP); and b) Height (EST), which together with the informed age were used to, in addition to characterizing the investigated sample, also to determine the body mass index-BMI, according to the protocols described below:

1. a) The PCT, understood as the result of the system of forces exerted by gravity on the total body mass (PITANGA, 2008), was measured using an electronic Filizola brand scale with a capacity of up to 150 kg and a precision of 1g, being their values expressed in kilograms - kg. The measurement was performed with the equipment positioned on level ground, with the individual being evaluated standing in the center of the platform, in an erect posture and with the head horizontally, legs slightly apart and arms relaxed along the body (PETROSKI, 1999) ; and
2. b) The EST, understood as the vertical linear length between the plantar region and the vertex (PITANGA, 2008), was measured using an Avanutri portable stadiometer with a precision of 1 mm, with its values expressed in centimeters - cm . The measurement was taken with the subject barefoot, the heels, buttocks, shoulder girdle and occipital bone in discreet contact with the perpendicular ruler. As recommended by standardization, a transverse cursor was slid along the ruler to the vertex, forming a right angle. The reading was carried out with the subject in maximum inspiration and with the head directed to the Frankfurt plane (PETROSKI, 1999).

Then, using the PCT/EST ^{2} mathematical model (PCT: total body weight - Kg; EST: height - cm) the calculation of the Body Mass Index - BMI was performed, which is understood as the relationship between the human weight and height ^{2} , whose index in kg/m ^{2} , statistically expresses a low correlation with height and a greater correlation with body fat (PITANGA, 2008).

Finally, to conclude the data collection for the study, the risk of coronary artery disease in the subjects comprising the sample was identified through the anamnesis instrument proposed by Sampedro (1996) and modified by Almeida (2011), shown below in table 1, which assesses on a growing scale of up to 80 points, the conditioning and causal factors that universally characterize individual risks for coronary heart disease, which, according to the score obtained, are classified as: Minimum (<16); Low (17-25); Medium (25-32); High (33-41); and Most High (>41).

CHART 1: Questionnaire to assess the risk of coronary artery disease.

FACTORS	PUNCTUATION					
AGE **- yearsold -**	10 – 20 Points: 1	21 - 30 Points: 2	31 – 40 Points: 3	41 - 50 Points: 4	51 - 60 Points: 6	> 60 Points: 10
FAMILY HERITAGE	0 relative with heart disease Points: 1	1 relative with heart disease Points: 4	2 relatives with heart disease Points: 8	> 2 relatives with heart disease Points: 10		
SMOKE	Does notsmoke Points: 0	Passive smoker Points: 5	Up to 10 cigarettes/day Points: 5	From 11 - 20 cigarettes/day Points: 6	From 21 - 30 cigarettes/day Points: 8	> 30 cigarettes/day Points: 10

WEEKLY EXERCISES - minutes -	> 240 Points: 0	120 - 240 Points: 2	80 - 119 Points: 3	60 - 79 Points: 5	31 - 59 Points: 8	<30 Points: 10
CHOLESTEROL - mg/dl -	< 180 Points: 0	181 - 205 Points: 2	206 - 230 Points: 5	231 - 255 Points: 6	256 - 280 Points: 8	>280 Points: 10
PA SySTOlIC - mm/hg -	110 - 119 Points: 0	120 - 139 Points: 2	140 - 159 Points: 4	160 - 179 Points: 6	180 - 199 Points: 8	>200 Points: 10
DIASTOLIC PA - mm/hg -	< 70 Points: 0	71 - 76 Points: 2	77 - 82 Points: 3	83 - 93 Points: 4	94 - 105 Points: 6	>106 Points: 10
B.M.I. - % -	< 18.5 Points: 0	18.5 - 24.9 Points: 2	25.0 - 29.9 Points: 4	30.0 - 34.9 Points: 6	35.0 - 39.9 Points: 8	> 40 Points: 10

Aiming to reduce and even avoid possible failures, during data collection there was the collaboration of five (5) researchers, all linked to the Group of Interdisciplinary Studies in Collective Health of the Federal University of Rondônia - GEFEU, which preceded the realization of the works were responsible for verifying the conditions of the material to be used with the subjects comprising the sample.

2.2 Statistical analysis of data

In this study, the data were analyzed using the following procedures: a) initially descriptive statistics was performed to characterize the sample; and b) subsequently, to detect in the subjects components of the study groups, GE-1 and GE2, possible significant differences between the scores related to their physical characteristics and study variables, Student's "t" test was used for independent samples. Data were processed and analyzed using version 10 of the computerized statistical package "STATISTICA for windows", from Starsoft Incorporation, seeking a significance of $p<0.05$.

III. RESULTS AND DISCUSSION

In order to characterize the sample, Table 1 shows the result of the Student "t" test for independent samples (mean values and their respective standard deviations), for the variables: Age (ID), Height (EST) and Body Weight Total (PCT) of EG-1 and EG-2, compared to each other with statistical treatment showing significant differences only in the variable ID ($p = 0.000$), demonstrating the heterogeneity of the sample.

Table 1. Statistical analysis of the physical characteristics of the sample.

VARIABLES	STUDY GROUPS				t	p
	GE-1		GE-2			
	n	ESCORES	n	ESCORES		
PCT -kg-	10	77,27 ± 9,85	13	80,76 ± 8,14	-0,934	0,360
EST -cm-		170,1 ± 7,47		155,3 ± 16,40	0,990	0,333
AGE -yearsold-		33,6 ± 2,91		42,4 ± 2,53	-7,789	0,000*

* significant at the indicated level.

Table 2 shows the result of Student's "t" test for independent samples (mean values and their respective standard deviations), for the study variables: Body Mass Index (BMI) and Risk for Coronary Disease, for EG-1 and EG-2 compared with each other, with the statistical treatment not showing significant differences of $p<0.05$ between their scores, having been found for the BMI of EG-1 a $p=0.313$ and for the risk of coronary artery disease in EG-2 a $p=0.236$. The mean values of the aforementioned variable (27.4 kg/m ^{2} and 28.7 kg/m ^{2} for GE-1 and GE-2, respectively), are classified as "overweight", since, considering the characteristics of the

subjects components of the sample, these values should not exceed 25 kg/m ^{2}to be bandaged as “normal” (PITANGA, 2005).

Table 2. Statistical analysis of the study variables.

VARIABLES IN STUDY	STUDY GROUPS				t	P
	GE-1		GE-2			
	n	ESCORES	n	ESCORES		
BMI - Kg/m ^{2} -	10	27,4 ± 2,80	13	28,7 ± 2,88	-1,033	0,313
RISK IN CORONARY PATHY - spots -		34,5 ± 7,16		37,6 ± 5,40	-1,219	0,236

When quantified in percentages, it can be seen that 20% of the subjects in EG-1 have a BMI classified as "normal", 60% are "overweight" and 20% are "obese", and in the individuals in EG-2 only 7, 8% have their BMI classified as “normal”, 61.5% are “overweight” and 30.7% are “obese”. The higher BMI values presented by EG-2 in relation to EG-1 corroborate other studies which state that body fat tends to increase with age, a fact that is associated with high energy intake, ethnicity, system activity sympathetic nervousness, thermal response to food, and the quality and quantity of physical activity performed by the subject, contribute markedly to the decrease in lean mass and increase in intra-abdominal and intramuscular adiposity (NOOIJEM, 2017; NOOIJEM, 2017; SILVEIRA, 2017).

Regarding the risk of coronary artery disease (CR), it appears that in EG-1 70% of the sample has it classified as "high", 10% classified as "low", 10% bandaged as "medium", and 10% as presents as "very high", and in GE-2 no element has the RC classified as "low", 77% is classified as "high", 11.5% as "medium", and 11.5% as "very high" . These results indicate that the combination of different risk behaviors such as smoking, drinking alcohol in excess, having low levels of physical activity and inappropriate dietary behavior increases the probability of overweight and obesity occurring, a fact already reported in previous studies (KNUTH et alli, 2011; REZENDE et alli, 2014; MENEGUCI et alli, 2015; MIELK et alli, 2015; SHAIKN et alli, 2015; CASSIDY et alli, 2017; CHAU et alli, 2017; MELO et alli, 2020).

Nevertheless, even though the high prevalence of physical inactivity in different adult populations has been recurrently proven, the literature has reported a lack of adequate strategies to monitor sedentary behavior in humans, as well as efficient interventions that awaken in them a more active lifestyle (MENEGUCI etalli, 2015; STREB et alli, 2020). In this regard, it can be assumed that, for a significant increase in population levels of physical activity, intersectoral actions are needed that propose the creation, among other things, of dynamic environments where the choice for physically active behaviors, and in its many dimensions , is motivated by values, and above all by pleasure, as crucial aspects for achieving significant improvements in overweight indicators,

IV. CONCLUSIONS

Probably the results found in this study are due, in large part, to the fact that the subjects in the sample have a daily life that is highly facilitated by the progress of mechanization, and also by other diverse devices that save a great deal of human physical work, which clearly instigate low levels of physical activity in everyday life. This fact, when associated with unhealthy lifestyle habits such as: smoking, drinking alcohol in excess, and inappropriate dietary behavior, increase the probability of overweight and obesity in the subjects, which may increase the primary risk factor for the onset of chronic degenerative diseases in them.

Considering that the population studied here is of adults, and that the negative implications of these attitudes, especially if adopted recurrently over the years, will predominantly be reflected when they become elderly, there are great possibilities of future involution of the general health status of these subjects for multimorbidities, functional incapacity and even early mortality. Thus, like other social classes, it is essential to make them aware of the change in behavior in relation to nutrition education and the practice of regular physical activities as important tools in the fight against overweight and obesity, in order to reduce the risk of development of cardiometabolic diseases,

Given the evidence found here, and the difficult scenario regarding the adoption of healthy habits in adult populations in general, future interventions are suggested that consider lifestyle-related behaviors in an interconnected way, preferably with a multidisciplinary approach in a number higher number of employees of the Judiciary Power, men and women, and with the same labor characteristics analyzed here.

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Germination and vigor in sorghum seeds under flood stress

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Abstract*—*The objective of this study was to evaluate the physiological quality of sorghum seeds under water stress. For the experiment, five lots of sorghum seeds with the same genotype (CMX5156A) and different physiological qualities were used. Five lots were submitted to different combinations of hypoxia time (4, 8, 16, 24, 36, and 48 hours under water) and temperature (20, 30, and 40°C). The moisture content, percentage of germination and emergence, height, and dry matter of seedlings from soaked seeds, were determined. A completely randomized experimental design in a 5 x 6 x 3 factorial, with four replicates, was used. The effect of hypoxia stressed the sorghum seed, affecting the germination of the seeds and emergence, dry mass, and height of the seedlings. The greatest decreases in viability and vigor were observed at higher temperatures and flood times. It is concluded that the germination and vigor of sorghum seeds are adversely affected by flooding. The submersion of seed in water at 40°C for 24 hours allows the segregation of sorghum seed lots.

I. INTRODUCTION

Modern agricultural markets aim for high-quality use of inputs, which encourages the development of new methodologies to determine the vigor and viability of seeds (AOSA, 2009). An efficient vigor test should be low-cost, fast, simple, objective, and reproducible, and the results must perform similar to the seedling emergence test in the field (Krzyzanowski et al., 2021). On the same hand, on-farm tests to estimate the physiological potential of seeds, which have low dependence on high-cost equipment and can provide fast, easy-to-interpret, and highly reproducible results, represent an additional advantage compared to traditional methods.

An alternative to determine seed vigor, is the flooding test, in which the seed to be evaluated is submerged in water and subject to stress by rapid imbibition and lack of oxygen. Under these conditions, there is an increase in the deterioration of physiological quality, compromising germination and seed vigor (Dantas et al., 2000; Zucareli et al., 2011). The limited amount of oxygen during the soaking period (hypoxia) is the mechanism and factor that underlies flooding as a test of vigor. This oxygen restriction induces a change from the aerobic airway to the anaerobic or fermentative one (Castro et al., 2004). This promotes the unbalanced formation of reactive oxygen species (ROS), which are highly deleterious, generating seed unviability or compromised seedling development and growth (Sharma et al., 2012).

Flooding stress on germination and seed vigor has been evaluated for several agricultural crops as a tool to evaluate seed lots, such as alfalfa (Bonacin et al., 2006), beans (Custodio et al., 2002; Bertolin, 2010), maize (Gazola et al., 2014), and soybean (Theodoro, 2013; Theodoro et al., 2018). There is a lack of studies evaluating the flooding methodology on sorghum seeds.

Hence, the objective of this study was to evaluate different periods of flooding and water temperatures on the vigor of sorghum seeds, in order to propose a new methodology of evaluating the physiological quality of sorghum seed lots.

II. MATERIAL AND METHODS

The research was carried out at the Seed Analysis Laboratory of Embrapa Milho e Sorgo. Seed lots with different levels of physiological quality were obtained by artificially aging the CMSX 5156 A genotype, at a temperature of 47°C for 0 (control), 24, 48, 72, and 96 hours (Lima et al., 2019). After the artificial deterioration of the lots, seeds were homogenized and stored in Kraft paper bags in a controlled environment (20°C and 60% relative humidity). The initial quality of each lot was characterized through evaluations of water content, carried out by the oven method at 105 ± 3°C, for 24 hours (BRASIL, 2009); and germination percentage, using 4 replicates of 50 seeds per batch, with each batch sown on filter paper moistened with distilled water in the amount equivalent to 2.5 times the mass of the dry paper, and placed to germinate at 25°C in gerbox-type plastic boxes. The count was performed five days after the start of the test, according to the criteria established by ISTA (2011). The emergence of seedlings in sand was mensurated by counting the emerged and complete seedlings, with evaluations carried out daily until 14 days after sowing (Santana & Ranal, 2000). Results were expressed in percentage of seedlings.

Additionally, a cold test was carried out using a cold chamber at 10°C, in which seeds were held for seven days on a paper roll (Costa et. al., 2011). After this period, the rollers were removed from the bags and placed in a germinator at 25°C for five days, after which point the percentages of normal seedlings were computed. Electrical conductivity was determined using four replicates of 50 physically pure seeds from each batch, previously weighed and immersed in 75 mL of distilled water, at 25ºC, for 24 hours. Each solution had its electrical conductivity evaluated, with results expressed in $\mu Scm^{-1}g^{-1}$ of seeds.

To measure the effects of seed flooding on the five different lots obtained by accelerated aging, a combination of flooding times and temperatures was used: temperatures of 20, 30, and 40°C, for 4, 8, 16, 24, 36, and 48 hours of submersion. The experimental design was completely randomized, in a 3 x 5 x 6 factorial scheme of temperatures, lots, and flooding times respectively, with four replicates. For each repetition, 50 seeds were used, and submerged in 75 mL of distilled water in 250 mL plastic cups.

After each flooding period, the sorghum seed samples were removed from the water and washed with distilled water. The seeds were then evaluated daily until the germination and emergence values stabilized. The final percentage and mean germination time on paper, and seedling emergence in sand, were determined (Ranal; Santana, 2006). At the end of the emergency readings, 15 representative seedlings of the set were collected in each replicate to determine the height and dry matter mass of seedlings from seeds subject to flooding processes.

The collected data were analyzed with an analysis of variance (ANOVA), and, in cases of significant effects, the means were compared by the Tukey test at 5% significance. For the quantitative treatments, regression methodology was applied using surface responses. Correlations were performed between the means obtained in the test of emergence values, using the simple Spearman model; and the correlation coefficients ($p \leq 0.05$), using the test t.

III. RESULTS AND DISCUSSION

The water content of sorghum seeds remained similar between the lots. There was a variation in the initial water content of 1.7 percentage points between the highest observed value (lot 3 with 13.1%) and the lowest (lot 1 with 11.4%) (Table 1). The other quality attributes were affected by different periods of exposure to accelerated aging, which established the constitution of different sorghum seed lots.

Table 1- Water content (WC), germination (G), seedling emergence (SE), cold test (CT), seedling dry matter (DM), seedling height (SH) and electrical conductivity (EC) of five lots of sorghum seeds.

Lots	WC	G	SE	CT	DM	SH	EC	Vigor
			(%)		mg	cm	$\mu S.cm^{-1}.g^{-1}$	level
1	11.4	93.2	95.7 a	88 a	60 a	26.67 a	41.78 c	high
2	12.7	92.2	94.7 ab	86 a	61 a	26.40 a	44.80 b	high
3	13.1	91.5	91.2 ab	88 a	55 a	24.27ab	42.60 bc	medium
4	12.6	92.2	91.0 ab	88 a	53 a	23.37 b	47.83 a	medium
5	12.9	91.5	89.0 b	84 b	36 b	19.90 c	49.73 a	low
Average	12,5	92,12	92,2	86,8	53	24,12	46,54	
C.V. (%)	5,4	1,4	2,93	2,16	10,75	5,11	5,8	

Means followed by the same letter in the column do not differ from each other, according to the Tukey test ($p \leq 0.05$).

The lots showed high germination performance, with values ranging from 91.5 to 93.2%, with no difference between them. In terms of vigor presented by the emergency test and electrical conductivity readings, lot 1 was classified as superior. On the other hand, lot 5 was classified as inferior because it exhibited inferior performance in the other vigor tests (seedling emergence, cold test, seedling dry matter mass, seedling height, and electrical conductivity). The inferiority of lot 5 was evident in majority of tests. Thus, the lots were segregated into three vigor categories for the analysis of the effect of seed flooding: high (lots 1 and 2), medium (lots 3 and 4), and low (lot 5).

It was observed that the viability and vigor of sorghum seeds were negatively affected by the increase in temperature and length of soaking, as seen in the variable germination, emergence, height, and dry matter mass of shoot (Table 2).

Table 2. Summary of analysis of variance for germination (G), seedling emergence in the field (E), seedling shoot height (SH), seedling dry matter (DM), mean germination time (MGT), and mean soil emergence time (MET) of five sorghum lots.

Source of variation		Mean squares				
	G	E	SH	DM	MGT	MET
Lot (L)	4	43.54**	5466**	103**	368.84**	0.17**
Temperature (T)	2	1636.42**	986**	256**	2276.74**	0.55**
Time (H)	5	562.61**	1273**	904**	6726.21**	0.23**
L x T	8	13.95 ns	206**	24.75**	25.81	0.03ns
L x H	20	21.65**	198*	15.28**	34.42**	0.06ns
T x H	10	416.24**	605**	14.41*	118.24**	0.10**
T x L x H	40	23.43**	113**	14.56**	334.02	0.04ns
Error	270	10.51	71	5.82	20.26	0.04
Average		89.18	70.7	19.18	24.65	3.87
CV (%)		3.64	12.04	3.64	18.26	4.09

*, **, 5 and 1% of significance, respectively, by the test F.

The germination percentage of the lots decreased as a function of the increase in period and temperature of flooding. The lots had greater decreases with exposure to 40ºC water (Figure 1) over time. For all evaluated times, at the lowest temperature of 20°C, the viability losses showed the lowest range of germination values. Over time,

the decreases were intensified after 4 hours of flooding, except for lot 3 which showed greater initial resilience (Figure 1). Under stress conditions, seeds can increase the formation of reactive oxygen species (ROS), which are highly harmful to cells and tissues at elevated levels, and can promote the oxidation of ADN, proteins, cell membranes, and, in more serious cases, cellular death (Soares; Machado, 2007). Intensification in the production of ROS can reach toxic levels and thus promote membrane peroxidation, electrolyte leakage, cell death, and consequently reduce seed germination and seedling vigor (Tunes et al., 2011).

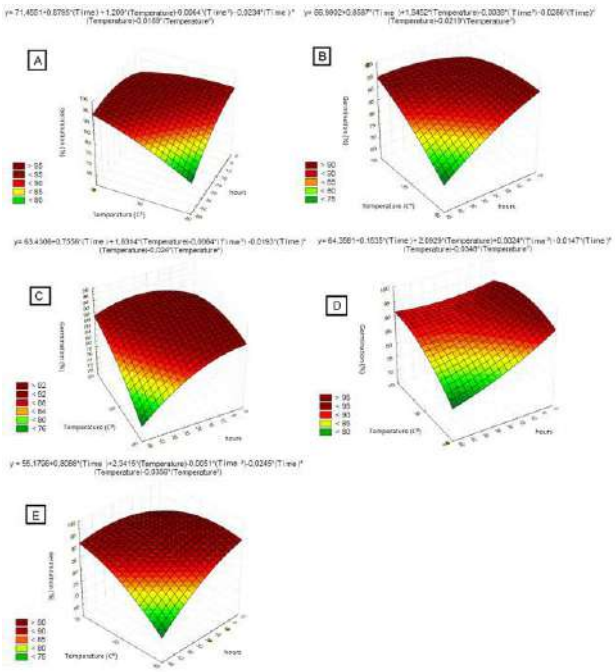

Fig.1. Surface responses to germination percentage of sorghum seed lots after flooding. (A) Lot 1 with high vigor, (B) Lot 2 with high vigor, (C) Lot 3 with medium vigor, (D) Lot 4 with medium vigor, (E) Lot 5 with low vigor.

In seedling emergence in the field, the sorghum lots showed different behavior at the temperatures studied, with the greatest reductions being observed at the highest temperature of 40°C. Decreases in this temperature ranged from 55.5% in lot 3 (medium vigor) to 67% in lot 5 (low vigor) (Figure 2). As the final temperature and the flooding time increased, the reduction in the percentage of emerged seeds for all lots were more significant (Figure 2). Therefore, it is important to highlight that under regular germination conditions, reactive oxygen species are controlled by antioxidant-metabolizing enzymes and used in the germination process as important signaling molecules (Bailly, 2004; Flores et al., 2014). However, when germination occurs in a hypoxic environment with high temperature, a redox imbalance occurs, observed in the high levels of ROS, which compromise the integrity of cells and, consequently, seed germination. In this sense, the lot with greater initial vigor showed greater tolerance to oxidative stress by flooding, demonstrating the importance of using seeds of high physiological quality, especially with high vigor, for stress conditions (Moterle et al., 2006).

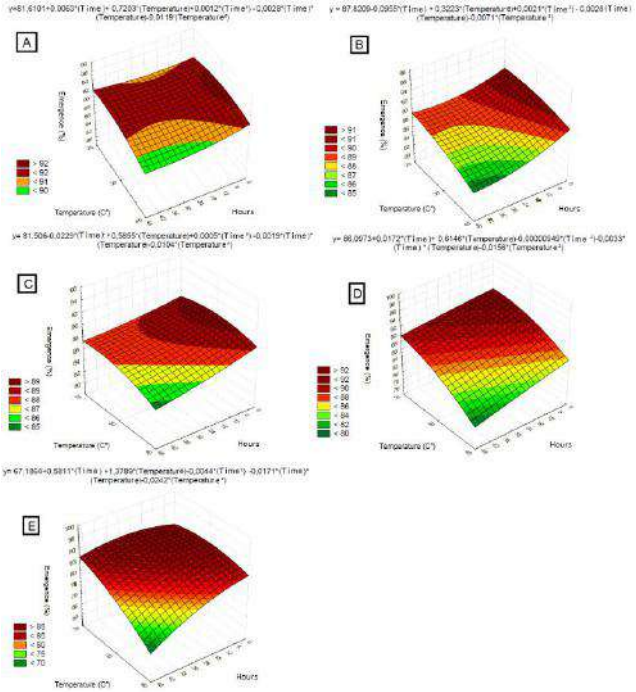

Fig.2. Surface responses of the percentage of emergence of sorghum seedlings after flooding. (A) Lot 1, (B) Lot 2, (C) Lot 3, (D) Lot 4, (E) Lot 5.

In terms of seedling dry matter mass, accentuated and linear decreases were observed in relation to the flooding periods in all lots (Figure 3). After 8 hours, the greatest reductions were observed, with the decrease in vigor being more accentuated when the seeds were exposed to temperatures of 40°C. The causes of reduced plantlet growth may be related to cellular turgor, which provides changes in metabolism according to the decrease in key protein synthesis during the germination process (Ge et al., 2014). These cellular turgor effects occur at the beginning of germination and can cause damage to the seeds (Oliveira et al., 2009).

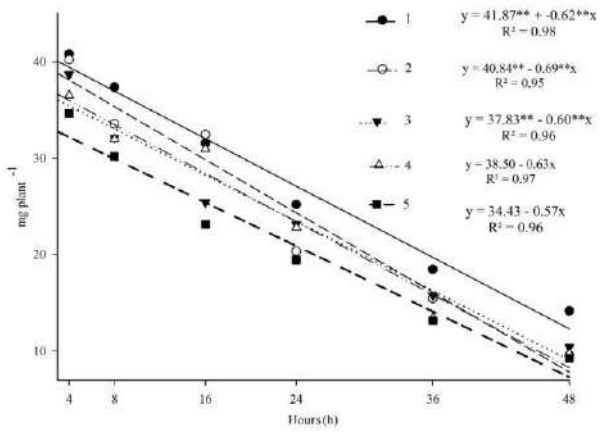

Fig.3. Dry matter mass of sorghum seedlings from submerged lots (1 and 2 with high vigor, 3 and 4 with medium vigor, and 5 with low vigor) at different times of hypoxia.

The hypoxia caused stress in sorghum seeds, particularly on seed vigor, influencing seedling development and growth (Table 3). There were lower rates of germination and emergence in the soil, with linear losses at the highest flooding temperatures.

Table 3. Regressions for mean emergence and germination time for sorghum seeds submerged in water at 20, 30, and 40°C, as a function of immersion time.

Temperature	Average emergence time		
20	$y = 5.38023725 - 0.14373980^{**}x + 0.0073051^{*}x^2 - 0.00009753^{*}x^3$	$R^2 = 0.9919$	< 0.0001
30	$y = 4.41550382 - 0.00538263^{**}x$	$R^2 = 0.7779$	0.0419
40	$y = 4.86044656 - 0.00904437^{*}x$	$R^2 = 0.7648$	0.0007
	Average germination time		
20	$y = 3.92979837 + 0.01057147^{*}x - 0.00127531^{*}x^2 + 0.00002251x^3$	$R^2 = 0.8547$	0 .0398
30	Y= 3.795		0.1277
40	$y = 3.97978817 - 0.00236116^{*}x$	$R^2 = 0.6378$	0.0383

** and * significant at 0.05 and 0.01 probability by the test F, respectively

These phenomena are extremely important for crop plants, especially given that sorghum has small seeds, is difficult to plant and has a competitive advantage in terms of phytosanitary factors (especially weeds) and rapid establishment and development in the field. Greater exposure to a hypoxic environment during germination may represent the same damage in seeds as drought, salinity, and high temperatures (Visser et al., 2003), because there is an increase in cytosolic pH when activating the fermentative pathways, which compromises, among others, the effectiveness of water transport by aquaporins that are sensitive to low pHs (Reddy et al., 2015).

In turn, the average times of germination and emergence in the soil did not undergo substantial variations, with low decreases due the treatments in both variables. The germination values ranged from 3.72 to 4.03 days, as expected for lots of appropriate quality seeds of this species. The same applies to the emergence in soil; it was found that the seedlings emerged at an average of 4.65 days. Treatments (time and temperature) with extreme values promote a low amplitude of only 0.91 days (Table 3).

The effect of flooding stress on sorghum seeds, as functions of the flooding periods and the reduction in vigor, partially corroborate the studies by Dantas et al. (2000) and Gazola et al. (2014) on maize seeds, and Custodio et al. (2002) on beans. These authors observed a significant effect on the seeds, and drastic reductions in vigor and viability of the seeds verified during the flooding test. Thus, it is believed that the high-water level, under conditions of high temperature during germination, caused seed metabolism to change from aerobic to anaerobic pathways. This change in metabolism can cause decreases in seedling yield attributes, according to species or genotype. Thus, when studying the effect of flooded soil on soybean plants, Ludwig et al. (2010) observed reduction in the physiological performance of seeds.

However, it is important to highlight that the speed of vigor-reduction during flooding can also be influenced by the seed size and permeability of the integument, which is variable among the species (Delouche, 2002).

Regarding the height of the aerial part of seedlings, it is observed that at a temperature of 20°C, the most vigorous lots (1, 2, and 3) showed greater resistance to flooding up to the 24-hour period of submersion in water (Figure 4). In general, lot 5, with the lowest vigor, showed greater sensitivity, as from 16 hours onwards there was a rapid reduction in this seedling attribute. At the highest temperatures, between 30 and 40°C, intolerance to flooding was noticed more quickly in the lower vigor lot, with an accelerated decrease in the height of the seedling shoots occurring after 8 hours of anoxia. The effect of temperature can be explained by the soaking process at the beginning of germination, when there is a high absorption of water by the seed, and oxygen becomes less available since its diffusion is up to 10,000 times slower in a liquid solution (Bewley et al., 2012). Absorption occurs faster at higher temperatures and in seeds with low vigor which present membrane disorder and decreases in vigor faster. Oxygen deficit compromises ATP synthesis, which contributes to the accumulation of harmful reducing power in tissues (Tommasi et al., 2001).

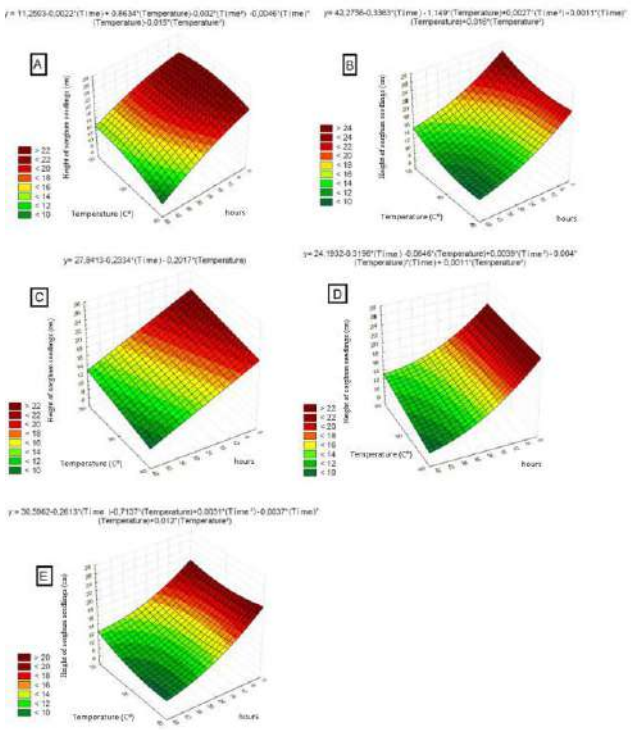

Fig.4. Surfaces response of height of sorghum seedlings after flooding. (A) Lot 1, (B) Lot 2, (C) Lot 3, (D) Lot 4, (E) Lot 5.

There was a significant correlation between flooding periods and temperatures, and seedling emergence (Table 3). Results correlating to emergence in field, indirectly represent the behavior of the lots in the field (Wendt et al., 2017). The use of flooding as a test for segregation of lots, is associated with stress that arises from the lack of oxygen and the release of toxic substances from the seeds' natural metabolic processes which initiate an energy expenditure higher than that of the seeds under regular conditions (Melo et al., 2012; Chen et al., 2013).

Table 3. Spearman's correlation coefficient (p) between the data obtained in the field emergence and flooding test of sorghum seed lots.

Flood period (h)	Flood temperatures (C°)		
	20	30	40
4	-0.10	0.36	0.79
8	0.20	0.10	0.46
16	0.36	0.30	-0.50
24	0.60	-0.30	0.97**
36	0.70	-0.10	0.70
48	0.50	0.95*	-0.60

* and **. Significant at 5% and 1%, respectively, by the test t.

It was observed that, in a solution under 20°C, there was no significant correlation with the periods evaluated (Table 7). However, at temperatures of 30°C for 48 hours and 40°C for 24 hours, there is a significant and strong correlation. In maize seeds, it was possible to observe different behaviors between hybrids during flooding, with the best combination of time and temperature being 25°C for 24 hours for the 30F35R hybrid, and 24 and 48 hours at 25°C for the 30P70H hybrid (Grzybowski et al., 2015).

IV. CONCLUSION

The germination and vigor of sorghum seeds are negatively affected by water stress.

The increase in temperature and periods of immersion in water cause a reduction in germination, emergence, height, and dry matter mass shoot of sorghum seedlings.

Soaking at 30 °C for 48 hours or 40 °C for 24 hours promotes the vigor classification of sorghum seed lots.

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Artistic Occupations in the Historical Center of São Luís (MA): Reflections on the revitalization and preservation of the cultural heritage of São Luís

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***Abstract*—** *Ours is an exploratory and descriptive field research, using bibliographic research and semi-structured interviews, aiming to discuss how the occupations "A Vida é uma Festa" and "O Circo Tá na Rua" in the Historic Center of São Luís contribute to the revitalization, democratization, preservation, and valorization of the heritage of the city. It conceptualizes cultural heritage and depict the artistic occupations of São Luís. It also punctuates how these artistic occupations give new meaning to spaces and enable the dynamic permanence of the idea that cultural heritage is not limited to ruins, mansions, works and monuments, but a living and under reconstruction by the political, social and cultural relations between those who inhabit it. Besides that, our study emphasizes the relationship between occupations and heritage, approaching the dynamic perspective that advocates for its continuous development, with changes arising from the contemporary uses that are given to it, placing subjects as a part of it. Finally, it ends by emphasizing that artistic occupations claim the preservation and valorization of heritage through its use, by means of bringing people closer to the cultural assets that make up the history of the place and the nation.*

I. INTRODUCTION

The Historic Center of São Luís (HCSL) is nationally known for having one of the largest civil architectural ensembles with traces of European origin that stands out as one of the main city postcards (Chaves, 2012). Despite being part of the history of the capital, traces of neglect are visible in the space. Some initiatives were taken by the government to revitalize the space; one of them was the development of an occupation policy by artistic collectives.

As one of the main exponents of both the State of Maranhão and Brazil in terms of heritage (Chaves, 2012; Costa, 2017), the HCSL has been an object of study in many different fields of knowledge. Investigating its nuances is essential not only to make the assets located there evident, but also to make known actions that favor the preservation and valorization of this space, which, over time, gained relevance not only for its architectural heritage, but also for its cultural richness. Therefore, this study aims to discuss the implications of artistic occupations present in the HCSL and highlight how these can contribute, not only to its revitalization, but also to the democratization, preservation, and valorization of the cultural heritage of the capital of Maranhão, starting from the occupation of its public spaces.

In this perspective, ours is an exploratory and descriptive study (Sampieri, Collado, & Lucio, 2013), which uses as instruments the bibliographic research (Marconi & Lakatos, 2017) as a mechanism to dialogue with authors dealing with Cultural Heritage and Artistic Occupations, among them Choay (2009), Garcia (2017), Paiva and Gabbay (2016), Medeiros (2002), and Fonseca (2009). With a qualitative approach (Marconi & Lakatos, 2017), an analysis of the productions was carried out, seeking to conjugate the categories tackled by the authors to the object of investigation, notably, occupations in the Historic Center of São Luís, Maranhão. To this end, the collectives A Vida é uma Festa and O Circo Tá na Rua located in the Historic Center of São Luís were investigated, with a view to analyzing how they contribute to the revitalization, democratization, preservation, and valorization of the cultural heritage of the city, based on empirical data from semi-structured interviews, whose testimonies were collected between October and November 2019, through field research with the support of the log book (Sampieri, Collado, & Lucio, 2013).

The article is divided into three main sections. The first section deals with artistic occupations, especially in terms of how these are constituted. The second section discusses cultural heritage in its theoretical-conceptual perspective, and also talks about listed heritage. The third section discusses the implications of artistic occupations in the Historic Center of São Luís, and how they contribute to the preservation and valorization of the cultural heritage of Maranhão. It depicts the Historical Center of São Luís, in addition to reflecting on the role of artistic occupations and their implications for the cultural heritage of the city.

II. ARTISTIC OCCUPATIONS AND PUBLIC SPACE

In the mid-twentieth century, there was considerable interest in analyzing the typical social processes of certain urban spaces. Studies such as those by Walter Benjamin, Georg Simmel, Max Weber and Guy Debord – the latter a pioneer in the problematizations regarding everyday life – gain important visibility, in order to break its logic alienated by the capital (Conceição, 2011). Conceição (2011) observes that there is a peculiar complexity in the relationship between people and the city and the spaces present in it, which results directly from the enjoyment of historical, political, economic, social, and individual transformations. Paiva and Gabbay (2016, p. 4) expand this perspective by stating that "[...] the city as a psychic space, thanks to the production of a chain of collectively sustained affections [...]" in the public space, seen as a place of democracy, relationships are established between individuals of common production: spaces for exchanges, contacts, dialogues, and affections.

Considering the public space as a place of democracy, Sartori and Garcia (2013) ratify the rich complexity of exploring the relationships belonging to it, characterizing it as a space for training and discussion of the public agenda, negotiated by the effective participation of civil society in its elaboration. But they also highlight the prevalence of private interests over public interests in the use of city spaces, that is, the elites (bourgeoisie and the State) hold the power to use spaces to the detriment of the needs and right of the population to enjoy them.

Corroborating this idea, Paiva and Gabbay (2016) find a relationship of causality between the occupation of public spaces and the privatization of cities. Developing countries, such as Brazil, adopt a North American urbanization model that imposes itself on the population: a global city full of commercial centers, malls, large buildings, in a state of continuous surveillance and asepsis.

Taking into account the artistic perception of the use of public spaces, the practices of art making in the street inevitably create bonds between the body of the individuals and the urban body, creating visible and invisible connections between everyone who participates in the action. This way of appropriating space, creating social bonds, goes against the spatial relationships arising from metropolization, in which the "being there", the sharing with the other, and the radical transformations in traditions practiced by the local community disappear (Moreaux, 2013).

These collectives that emerge in cities tend to identify and legitimize their real problems and propose ways to solve them, something that was once common in small cities, is now necessary in large metropolises, in a real need to reorganize the city and its public spaces (Durán, 2008). Therefore, Garcia (2017) emphasizes on new socio-spatial configurations of culture and city that such re-significations of public space occur because there is a collective identity built on symbolic values that expand the common characteristics of residents and users of that space through the construction of signs of well-being and satisfaction.

Artistic-cultural occupations can be considered as a model of collective action that uses artistic practices in empty, abandoned, or underutilized urban spaces, as a political tool for reflection and mobilization of society, in order to promote full participation in its management and use, placing itself as a social movement of demand and resistance to the commodification of public space by the capitalist system, promoting the practice of direct democracy, citizenship and the right to the city.

III. INDENTATIONS AND EQUATIONS

When reflecting upon Cultural Heritage and what it represents leads us to the need to recall – even if briefly – its constitution and conceptualization. Although countless decades have passed, its semantic construction is still marked by new categorizations and appropriations. Beforehand, a first attempt to establish a concept was made by looking in the lexicon of the word. Vogt (2008) emphasizes that Patrimony comes from the Latin patrimonium, which means paternal inheritance, or that which integrates the parter, that is, the father.

Silva (2017) complements, stressing that, in the Portuguese language, the term "heritage" is defined as that inherited from parents, family assets. In this sense, Choay (2009) highlights that the concept of heritage is related to family structures, however, over time it also started to encompass other meanings, aggregating genetic, historical, and cultural aspects. Relating itself to different aspects, not only from a patriarchal perspective, but also one closely associated with monuments – this at the expense of the influence of Architecture, Visual Arts, Anthropology and History (Pereira, 2017) – it is emphasized that the genesis of what is understood by heritage began in the 18th century, and in Classical Antiquity and the Medieval Age the term also had great notoriety (Choay, 2009).

The views pointed out by Pereira (2017) and Choay (2009) reverberate in the views of the society regarding the cultural heritage, since it is seen as something untouchable, with restricted access, which reveals the resistance that the population has in the face of occupations in the Historic Center of São Luís, for example, sometimes seen as something transgressive. Furthermore, it is noteworthy that the concept of monument provided reflective conditions for the concept of heritage itself to be outlined, given the historical importance given to the demarcation, control, and enumeration of monuments, as Studart (2017) points out.

According to Rocha (2018), the historical construction of the meaning of heritage has expanded and changed, no longer contemplating only historical monuments, but also including elements such as language, rhythms, tastes and flavors. Thus, we can emphasize that "Cultural heritage is a process of symbolic construction that has sociocultural, natural, technical, political and economic dimensions." (Fernandes, 2017, p. 32).

Thus, it can be said that the arrival of the 20th century brought with it the expansion of the patrimonial domain, considering that everything related to heritage, especially its objects, needed to find "resonance" in society, whose actions of conceptualization and application were outlining themselves. After World War II, the purposes and values of heritage were re-qualified, especially in contemporary Western societies, as explained by Choay (2009) and Grimaldi (2016).

Based on this, we highlight that "Heritage is currently the enjoyment of a wide range of activities. In the cultural sphere, it was incorporated due to its artistic and artisanal productivity, in addition to the vision that considers artifacts and intangible goods as worthy of preservation." (Silva, 2017, p. 16). In the arrangement of elements that intend to delineate the cultural heritage presented by Silva (2017), it is possible to include artistic occupations, as they are also responsible for remarkable artistic production and for their presence in the redefinition of public spaces, such as those that are the target of this study. As explained above, the heritage assets listed here are important exponents for the consolidation of the understanding of heritage and what it represents, not restricted only to architectural constructions.

Supporting this notion, Rocha (2018, p. 28) states that Heritage can be understood as "[...] historical and cultural assets, of a collective character, that is, belonging to a certain social group with the intention of expressing a given moment or collective memory, serving to build and/or reinforce the identity memory of this group." Furthermore, it is pertinent to emphasize that on the threshold of the 20th century, the historical and artistic national heritage began to encompass nature, which, according to Medeiros (2002, p. 41), is "[...] understood, then, as 'landscape', and to archaeological objects and sites [...]." So, there was a new moment for heritage, as its dimensions transcended national boundaries, conquering international spaces, paving the way for UNESCO (Pereira, 2017; Medeiros, 2002).

Heritage preservation emerges from the need for spaces capable of preserving and safeguarding memory. Memory is also placed as an important category related to heritage. In this sense, patrimonialization stands out as a political-institutional mechanism that reinforces the importance of heritage as an entity responsible for the public memory of a people. Consequently, according to Funari and Pelegrini (2009), patrimonializing consists in legitimizing a public good, which in turn must be preserved.

Therefore, cultural heritage – both material and immaterial – is endowed with several dimensions, which must not only be preserved, but because they represent an entire historical legacy of our ancestors, they must be passed on to future generations. With that, the heritage will acquire new meanings and interpretations, that is, it will compose new realities. Therefore, it must be understood as a discursive formation, responsible for mapping symbolic contents, not restricted to the simple description of how a

particular nation is formed, but, above all, how it builds its cultural identity.

The Historic Center of São Luís is part of the heritage of the city and in recent years it has been a space for diversified activities, including the Book Fair, alternative and popular Brazilian music festivals, artistic interventions and occupations. Such practices not only give new meaning, but also give a new perspective to this space loaded with memory and symbols of the culture of Maranhão. In the next section, such practices will be discussed, especially how artistic occupations affect citizenship actions, preservation and valorization of the public heritage of the State.

It is pertinent to emphasize that identifying, preserving, and conserving material and intangible assets is not enough by itself, not when wanting actions to be consolidated. Interdisciplinary work with the population is essential in the spaces of socialization of cultural heritage, highlighting the artistic occupations, especially those that act as vectors for the requalification and redefinition of public spaces in São Luís, installed in the Historic Center of the capital. In this sense, the next section goes on to address how such occupations can be remarkable vectors for promoting the development of policies and actions for the preservation of cultural heritage, as well as vectors for encouraging tourism, conscious use of public spaces, and the strengthening and practice of citizenship.

IV. THE ARTISTIC OCCUPATIONS AND ITS IMPLICATIONS FOR THE VALORIZATION OF THE CULTURAL HERITAGE OF SÃO LUÍS-MA

The Historic Center of São Luís is internationally known for its beauty and for being an area of great historical and cultural value, as well as architectural and scenic value (Cutrim; Costa; Oliveira, 2017). The central region of the capital of Maranhão had its emergence associated with the main economic locus of the cityt: the port and its coastal region. The Praia Grande region was the great commercial nucleus in the beginning of the colonization of São Luís, becoming the loading and unloading point of the market flow of import and export, constituting the genesis of the city and its society.

As the center of São Luís is the result of human actions, overlapped by different periods of time, and considering the advance of trade and commercial relations established in Praia Grande, its historical and cultural value was consolidated, and today it is considered one of the most important spaces of the capital of Maranhão (Noronha, 2015). The Historic Center of São Luís has unique characteristics. It is a place where the culture and history of Maranhão are expressed through tangible and intangible elements, in aromas and flavors, cultural manifestations and occupations, responsible for keeping alive and recovering all the memory and identity of the place (Cutrim, Costa, & Oliveira , 2017, Santos & Lorêdo, 2013, Ferreira, 2008).

The Historic Center of São Luís has an extension of approximately 220 hectares, comprising the neighborhoods of Praia Grande, Desterro, Apicum, Codozinho, Lira, Belira, Macaúba, Coreia and Madre Deus.

Founded by the French around 1612, the Historic Center had then its nucleus established. After the battle of Guaxenduba, the Portuguese, then led by Jerônimo de Albuquerque, brought to São Luís in 1615 the engineer Francisco Frias de Mesquita, in charge of planning the entire space (Mendes, Sousa, & Marques, 2016).

The urban plan of São Luís presented the same architectural models of other historic cities, such as Rio de Janeiro and Recife (Costa, 2017; Mendes, Sousa, & Marques, 2016). In mid-1641, São Luís was then taken by the Dutch, led by Maurício de Nassau. It is noteworthy that during this period some churches were damaged, such as the Church of Desterro, the Church of São João Batist – the latter was only recovered about twenty years after the expulsion of the Dutch, in 1644, in a movement led by Teixeira de Melo (Branco et al ., 2017; Mendes, Sousa, & Marques, 2016).

Thus, the Historic Center of São Luís "[...] depicts the homogeneous remnants of the 18th and 19th centuries represented by the townhouses with facades covered in Portuguese tiles [...]" (Mendes, Sousa, & Marques, 2016, p. 4). The Historic Center of São Luís has a unique architectural ensemble, which expresses all the economic power of the capital in the colonial period, especially due to the abundance of Portuguese tiles. São Luís was considered one of the most prosperous cities in the country, thanks to the large production of cotton, rice, among other genres (Silva, 2009a).

Although it expressed the heyday of the capital of Maranhão in the colonial period, the Historic Center, from the 20th century onwards, was abandoned. This was due to the departure of older residents, who were occupying finest spaces of the city, and the fall of commerce in the place, resulting in "[...] processes of ruination of several constructions in the urban fabric of that area [...]" (Silva, 2009a, p. 2).

It is noteworthy that in the 1940s, people in power were already seeking to put in effect the prerogatives of Decree-Law No. 25/1937, whose objective was to protect the heritage assets of great value to the country. With this, the fight to protect the architectural ensemble of the

Historical Center of São Luís gains strength. According to Andrès (1998, p. 104), Maranhão takes an important step with the "Federal Listing of Sambaqui do Pindahy, Process 211-T-39; Inscription No. 6, Archaeological, Ethnographic and Landscape Book, page 02, 19/01/1940 [...]", the first federal listing in the State (Silva, 2009a).

Other listings were also made, these being fundamental for the Historic Center of São Luís to acquire even more value, especially for its architectural arrangement. Actions aimed at preserving the heritage properties of the State, especially those located in São Luís, were consolidated in 1974 by the Service for the Historical and Artistic National Heritage (SPHAN) (Cutrim, Costa, & Oliveira, 2017).

In a moment of great importance not only for Maranhão, but for Brazil, the Historic Center of São Luís was born, thanks to the actions of the Institute for National Artistic and Historical Heritage (IPHAN). According to Cutrim, Costa and Oliveira (2017), the Historic Center concentrated the main preservation activities, as it brought together a grandiose architectural ensemble and "[...] because it is a living historic city, due to its very nature of capital that despite its expansion, São Luís continued to preserve the urban fabric of the 17th century and its original architectural ensemble." (Mendes, Sousa, & Marques, 2016, p. 4-5).

After the national recognition of the architectural ensemble of Center of São Luís, on December 6, 1997, the Historic Center was internationally recognized by the United Nations Educational, Scientific and Cultural Organization (UNESCO), receiving, in addition to the listing, the title of Cultural Heritage of Humanity (Silva, 2017; Mendes, Sousa, & Marques, 2016).

In recent years, The Historic Center of São Luís has been a space for diversified activities, including the Book Fair, alternative and popular Brazilian music festivals, artistic interventions and occupations. Such practices not only give new meaning, but also give a new perspective to this space loaded with memory and symbols of the culture of Maranhão. In the next section, we will discuss how such practices, especially artistic occupations, affect citizenship, preservation, and valorization actions of the public heritage of the State.

V. ARTISTIC OCCUPATIONS AND THEIR IMPLICATIONS FOR THE CULTURAL HERITAGE OF SÃO LUÍS

Although the movements of artistic occupation in the Historic Center of São Luís have been around for a long time (consider, for example, the 30 years of the collective A Vida é uma Festa), it was through the extinction of the Ministry of Culture, in May 2016, by the interim government of Michel Temer, that the term occupation takes on a greater meaning of struggle and resistance on the part of the local artistic class, by the movement called OcupaMinc-MA , with São Luís being one of the pioneer capitals in the occupation of IPHAN buildings throughout Brazil, under the allegation of the illegitimacy of the current government and the loss of basic social rights.

Since then, in the artistic world of the collectives operating in the historic center of the capital of Maranhão – although they already had characteristics of occupations – the format of public spaces occupation as a mechanism of civil society for the maintenance and guarantee of free public cultural activities for the community became part of the discourse and the slogans of the actions, in a more incisive way.

Duran (2008) sees these collectives as legitimate representatives of the most diverse categories of society, which occupy public spaces not only with the intention of using them for entertainment and leisure only, but to identify the problems present there and find collective ways to solve them, in opposition to the spectacle culture of governments that create well-trained and apathetic audiences, consumers of a ready-made narrative that does not problematize the space in which it is inserted.

Specifically in São Luís, there were two actions that came close to the fostering of artistic production in the format of occupations: the public notice Pontos de Cultura, carried out by the City Hall through the Municipal Department of Culture, in 2016, and 04 public notices for occupation in specific points of the historic center of the city, in 2017. It is important to emphasize that both actions were mainly aimed at popular culture groups and collectives. (Maranhão, 2017; Brazil, 2015). Given the non-continuity of public policies in changes of government, which does not only occur in Maranhão, but across the country, there is always a deficit of affirmative actions in the field of culture, especially those focused on the format of artistic occupations.

It is in this scenario of incipient development actions and instability in the maintenance of cultural policies that some occupations resist acting in the Historic Center of São Luís. To better elucidate the discussion, two occupations with different characteristics of spaces, artistic segments, forms of occupation, and length of trajectory, in order to relate them to aspects of preservation and heritage valorization.

The first one is A Vida é uma Festa which, in short, is a meeting of former musicians who frequent the Historic Center of São Luís on an open stage of improvisation and musical shows. It has become a traditional attraction and

has been taking place every Thursday night at Praia Grande for the last 30 years. The program occupies the street Ladeira do Comércio, in the back of the Creativity Center Odylo Costa Filho with a wooden platform, speakers, microphones and some musical instruments, building a clear invitation for anyone to participate on the open stage.

Coordinated by Zé Maria Medeiros, singer and composer from Maranhão, the meeting is filled with various songs and sounds from the local popular culture, added to the traditional rhythm of Tambor de Crioula circles and musical shows, sometimes improvised, sometimes with invited local groups. The flagship of the actions of the collective is the preservation of the traditions of popular culture from Maranhão, with instruments typical of the traditional rhythms of the State, such as zabumbas and pandeirões from the feast Bumba-meu-boi and the tambor grande or rufador, meião or socador and crivador or perenga, used in the Tambor de Crioula.

Furthermore, A Vida é uma Festa has occupied the address Casarão nº 210 on Comércio street for 28 years, in addition to the area on the street in front of the property. The original movement was called Companhia Circense and, before the occupation, promoted music and circus shows in the streets of the Historic Center of São Luís. In the first 10 years, the Company continued to promote activities inside and outside the occupied property, with the event A Vida é uma Festa taking place there every Thursday night with attractions such as the traditional Tambor de Crioula and musical shows. With the ending of the initial formation, the latter remained as the main action of the occupation.

In turn, the collective O Circo Tá na Rua, as the name implies, occupies the Nauro Machado Square, located on the Estrela street next to the João do Vale Theater, offering free and public circus training. Different from the first, this occupation has existed for seven years and brings to the public space a proposal of educational action, given that many of the direct collaborators of the collective started their career as circus artists with the practice developed in the meetings. The group provides various materials from the circus universe for the population to experiment and learn about, such as stilts, juggling materials, a tatami area for floor acrobatics and the allusion to traditional tightropes and wire through the slackline , the practice of balancing oneself on a tensioned tape.

In this collective the management is collaborative. The coordination of actions is not centered on a single person. The organizational structure of the collective takes place through direct collaborators, who participate in actions beyond the weekly training sessions, and indirect collaborators, who are all those who attend training assiduously and thus collaborate to maintain the collective. It is worth mentioning the networking of the group with other sociocultural groups from different neighborhoods of the island as a strategy to strengthen the occupation of public spaces.

Regarding the interventions carried out, Article 17 of Decree 25/1937 – which organizes the protection of the national historical and artistic heritage – establishes that listed federal assets cannot be painted, restored or repaired without prior authorization from the competent body, under penalty of fine of 50% of the cost to correct the damage done (Iphan, 1937). Brandão (2016) comments on the contradiction between the positive aspect of artistic-cultural occupations in making use of spaces open to the population and the illegality of interventions that operate without the authorization of the technical staff of preservation agencies.

In contrast to what was observed in the 1937 instrument, such interventions are considered by Brandão (2016, p. 69) as "[...] responses sensitive to the historical object. These are the cases of interventions associated with the identity of the groups or that pose as creative solutions to the needs of use.". These are works of art that consider the authenticity of the property, do not modify its original concrete structure, but demonstrate the relationship of the occupants with the materiality of the occupied place, adding a new layer of history to the existing one attributed to the building.

From the relationship between occupations and cultural heritage, the main phenomenon elucidated by the occupants as a motivation to give new meaning to spaces, is given by the so-called "urban voids, spaces abandoned by the owners and by the public administration that generate public safety problems for the community. Regarding the Urbanism theory, these voids are spaces that have lost their social function or do not suit the population's needs, generating an opposite, generally negative, evasion effect of people who inhabit and visit the place, in addition to focusing on illicit activities and urban violence (Borde, 2006).

In this case, the reinterpretation of the square's space occurs as a transposition caused by the absence of the Circo da Cidade. The urban void that the removal of the equipment left, both in the urban fabric and in the imagination of the artistic class, especially the circus segment, mobilizes the need for a public space that meets the needs of cultural production in this area and meets an artistic demand lack of public cultural equipment specific to their activities.

In both occupations, it is observed that the main collaboration with the preservation and enhancement of the Historic Center of São Luís as a cultural heritage is the presence of the people in the heritage space. As stated by Gonçalves (1996, p. 97, emphasis added), when analyzing the speech of the director of SPHAN, Rodrigo Melo de Franco Andrade, who held the position in 1937 and remained until the end of the 1960s, "[. ..] the main factor in the process of disappearance of the national historical and artistic heritage is the indifference of the population [...]", which overcomes social class distinctions and is linked to the loss of Brazilian cultural identity.

It is noted that not only in the cultural facilities, but also in the streets of the Historic Center, there is space for artistic work, as stated by the occupation A Vida é um Festa (2019, verbal information): "[...] We always worked with the idea of making art on the street [...] I think this is very important, the street is an open, democratic space. People can choose to be there [...]". The dynamics of use of the city given by the artists goes against that pointed out by Oliveira Neto (2012), where, since the beginning of the 20th century, the privatization of living spaces has been adopted as a synonym for security and social well-being, placing living spaces in hermetic zones, such as shopping malls and gated communities, while the street becomes a place of danger and social vulnerability.

In this sense, the actions carried out by artistic-cultural occupations are sometimes marginalized. The Collective O Circo Tá na Rua reports on such situations:

> The police, nowadays, we just try to ignore it, right, to ignore its existence. The police action Blitz Urbana already wanted to stop us, the police already tried to blur it [injure, prevent]. We don't try to fight either, they stay in their lane, and we stay in ours [...] with these guys [the police] we realize that there is a barrier: they don't care about us and we're ignoring them too. The Blitz Urbana has already tried twice to take us out of the square because we don't have a permit to be there, and we don't do anything but put the materials, we don't drill into the square, we don't do anything, everything that we put in, we take out, and we even clean the space when we do something that dirties the place. (O Circo Tá na Rua, 2019, verbal information).

It is common to find reports of confrontation with the Military Police in other experiences of artistic-cultural occupation, especially when it comes to actions considered transgressive, such as the use of graffiti in the research by Monasterios (2011), Nasser (2018) and Chagas (2015) . When there is subversion to the institutionalization of art and the proposal to change the urban landscape taken care of by the public administration, the occupation movements end up in direct confrontation with the police, in addition to repossession actions and other attempts to impede the carrying out of activities.

This healthy relationship between the occupation and the government also appears in the history of the occupation A Vida é uma Festa:

> The culture secretary, who put us here, was at the time with PRODETUR, which was the body in charge of the revitalization project for Praia Grande, in the Historic Center. At the beginning, when they revitalized this here, which was an abandoned area, many buildings were handed over, it wasn't even lending, they were handed over to people... When at the end of his term, he [the secretary] gave us an authorization to occupy this building, it was the entire building, then the Government changed, we had to divide the building, on top was COTEATRO, below us, and that's where we are today [...]. (A Vida é uma Festa, 2019, verbal information).

Some possible inferences can be drawn from the above account. The first concerns the possible relationship of greater proximity between the government and artistic and cultural activities, or the second, such proximity was due to personal ties of proximity/friendship with the members of the occupation. Rubim (2007) points out such interferences in the personal relationships of those in political positions in the direction of public policies for culture in Brazil with the purpose of contemplating their own interests, preventing the artistic class and the population in general from fully accessing them.

It is noteworthy that this analysis does not condemn the granting of public spaces for artistic-cultural use to be carried out in an easy way, nor the proximity of the public entity with local cultural agents of the most varied artistic formats and segments, but that it is part of the public agenda federal, state and municipal recognition and insertion of artistic-cultural occupations as legitimate actions that contemplate the dimensions of the concept of culture proposed in the PNC 2010-2020.

From this recognition of the actions of occupations in their symbolic dimension, by valuing the ways of living, the citizen dimension, by promoting universal access to cultural goods and public facilities in the city and, in the economic dimension, by their activities valuing sustainable use and community spaces, avoiding their predatory and destructive use in commercial monopolies, as well as the attempt to promote a fair and sustainable economic development, sustaining "[...] flows of formation,

production and diffusion suited to the singularities constituting the different artistic and multiple cultural expressions [...]" (Brasil, 2008a, p. 12).

It is noted that artistic occupations claim the preservation and enhancement of heritage through their use, through bringing people closer to the cultural assets that make up the history of the place and the nation. The distancing produced both by the laws and by the commercialization industry of cultural capital vanishes when the population takes over the spaces and from them develops actions aimed at social well-being, with a view to revitalizing underutilized public spaces and, in fact, contribute to the democratization of culture.

Far from simplifying the safeguarding of the heritage of the Historic Center of São Luís to the use of public spaces by the population, the relationship that people develop with the space is highlighted in strengthening their identity recognition with the cultural assets present in the heritage areas. The idea of socialized heritage, in which subjects inhabit, use and become part of the place, is corroborated, recognizing the memory and history of that space as part of their own identity (Almeida, 2017; Choay, 2009).

The relationship between occupations and heritage approaches the dynamic perspective that advocates its continuous development, with changes arising from the contemporary uses that are given to it, placing the subjects as part of it, as shown in the report below:

> [...] These artistic occupations, they know what those spots are, they don't go there for nothing, they are careful, they know what it is, or maybe it was that big house, and then they say: "- let's preserve this place because there can be more [...] feedback from this place, the more I take care of this place, I can stay longer in it, I can make more people have this experience in this place, and I continue to preserve my São Luis, right?" With all the history it carries, and I end up putting one more story in this space... as an artistic occupation, which preserves this place, which wants to give it more movement. (O Circo Tá na Rua, 2019, verbal information).

This practice, from the social function of the public heritage space for people, presents itself as a resistance to the patrimonialism process that is sometimes inherent in the revitalization programs of historic centers in Brazil. It is the conduct on the part of the public sphere that generates the indistinction between the public and the private, due to the use of State power for its own interests, generally in common with those of large companies with financial capital to invest in the urban restructuring of these locations that correspond to their profitable interests (Almeida, 2017).

Through the context, after the characterization and analysis of the occupations studied here, the collective acts of occupation are placed, in addition to the political stance of resistance, as practical actions that demonstrate the reinterpretation of these spaces, seeking to contemplate cultural, social, economic issues, as well as agents promoting citizenship through active, direct social participation, aware of the preservation of heritage and willing to transform it into the benefit of the city. It can be said that both housing and artistic-cultural occupations are neglected in urban restructuring programs in progress since 2019, when compared to investments with marketing purposes, confirming the business direction that is being given to the Historic Center of St. Louis.

Thus, as Lefebvre (2008) proposes, art could deal precisely with this future, in not only artistic, but urban creations, on a social scale, transforming daily practices into ways of living the city as a work of art, of belonging to the urban thing. Aligning, as artistic-cultural occupations do, with the idea of culture present in the PNC (2010-2020) (Brazil, 2008a), as a transversal concept that permeates all instances of human life, not in a contemplative way, but as a structuring element of the social being, which relates to others, to the space around them, understanding the city as a project under construction, exorable by the collaborative collective action between public authorities and civil society.

Artistic-cultural occupations build new meanings in urban spaces as they, in addition to giving them new uses, instigate the population to rethink the city, strengthening its relationship with the public space through appropriation strategies with the use of art, in its entertainment and leisure dimensions, as well as training and professionalization. In the case of the Historic Center of São Luís, practices related to the artistic segments of Music, Theatre, Circus and Popular Culture were identified, in the form of presentations and workshops.

A kind of political resistance is articulated in the public space on the part of those who occupy them, both to preserve it as an area of promotion and enjoyment of local cultural production, ensuring that there are spaces that contemplate its artistic diversity, as well as to pressure the public sphere to direct investments in cultural facilities that meet the needs of the population, especially for those who still inhabit the Historic Center of São Luís, and not only for tourist and spectacularization purposes.

In summary, artistic-cultural occupations show potential as a social movement of collective mobilization of action in public spaces, mainly based on the claim of the

right to the city, using artistic practice as a tool for transforming urban ways of life, minimizing the effects of widespread commodification that affects people's daily lives, as well as promoting the dissemination and democratization of cultural goods and the exercise of citizenship, through free access to public spaces, without distinction of gender, race or social class.

VI. CONCLUSION

Since the first attempts to draw a concept of heritage, people realized its concept was related to several other concepts, representing aspects involve notions such as affiliation, monuments, identity traits, among other elements. We understood, after all, that even when different terminology is used – material, immaterial, cultural heritage, etc. – these concepts converge in the different dimensions that the heritage contemplates.

All the elements that constitute the perception of heritage are nothing more than heritage assets that, regardless of their typology or classification, must be preserved and kept alive, as they portray the memory, identity, history, knowledge, and practices of a people, therefore, they must be there for the next generations. Thus, we now realize that the conceptions of heritage will be re-signified over the years, reflecting the different realities demarcated in space and time.

The researchers found regarding the preservation and revitalization of the Historic Center of São Luís contemplate mostly the architectural issue of Material Heritage and others related to the Intangible Heritage of traditional segments of popular culture such as Tambor de Crioula and Capoeira. Against this solidification, from the idea of heritage as a contemplation of the past and traditions, occupations are anchored in currents that understand it as a set of collective goods, belonging to the collective memory of those who live there and build their identity in the everyday of established relationships with that heritage space, as well as in the production of new cultural goods.

Strictly speaking, it is possible to observe the peculiarities that each artistic-cultural action adds to the public space. Micropolitical actions of resistance, occupation and appropriation by the artistic class generate demands that reverberate in the community that inhabits the Historic Center, in those who are just passing through, such as tourists, national, foreign, or local, as well as in the public entity, in particular in the institutions responsible for the administration, maintenance, planning and preservation of the historical heritage that comprise it.

Thus, artistic occupations permeate time and space, bringing new meanings to it and enabling the dynamic permanence of the idea that cultural heritage is not limited to ruins, monumental mansions or untouchable works and documents. Moving away from the hegemonic conceptions of national identity and the overvaluation of the traditional, they bring to the public space new possibilities for thinking about and problematizing heritage preservation policies that, in addition to preserving history, need to allow the people to recognize themselves as part of it. and can actively participate in its enhancement and (re)construction.

Re-signifying the public heritage space is directly linked to guaranteeing the right to the city, recognizing its dynamics as a project under collective construction, with the participation of the public, private and civil spheres of society. The artistic-cultural occupations are placed, in measure, as a sentient thermometer for the balance of the relationship between these spheres, acting in a form of protest and resistance to the imbalance of interests that impact the city's space, as well as a continuous alert mechanism for reflection on the place that the population occupies in this context, confirming the need for direct social participation in the social field of power dispute between such social agents.

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Echocardiography during cardiopulmonary arrest: Integrative review

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***Keywords*— Cardiopulmonary Resuscitation, Echocardiography, Heart Arrest, Heart Rate, Point of care.**

***Abstract*—** *Introduction: The identification of the rhythm in the care of the patient with cardiopulmonary arrest (CA), (shockable and non-shockable) is fundamental for the reversal of the condition. In this context, echocardiography (ECHO) allows real-time recognition of myocardial movement and helps to identify the potential reversible cause of CA in non-shockable rhythms such as PEA and Asystole. Objective: to present an update of the scientific evidence about the use of ECHO during CA. Method: integrative literature review, in the Medical Literature Analysis and Retrieval System Online database, using the descriptors "Echocardiography" and "Cardiac Arrest", with original articles published between 2019 and 2021. Results: the use of ECHO during CRP allows visualizing the movement of heart chambers and valves, blood flow and myocardial contractility, helping to identify the cardiac rhythm and, in turn, the cause of the shock. The use of transthoracic echocardiography (TTE), a non-invasive method, requires pauses in chest compressions and is interfered with by external or patient-related conditions. Transesophageal echocardiography (TEE), in turn, does not require interruption of chest compressions and provides more reliable images, but it is a semi-invasive method. Conclusion: the use of ECHO during CA helps to identify the cause of shock, which provides adequate case management and predictive definition. Due to the non-interruption of chest compressions, the use of TEE proved to be an alternative to TTE, but with a longer learning curve and lack of studies with outcomes such as survival and prognosis.*

I. INTRODUCTION

Cardiopulmonary arrest (CA) is the cessation of cardiac mechanical activity as confirmed by the absence of signs of circulation [1].

It consists of a worldwide public health problem, with an incidence of 47.3/100,000 per year in the United States (USA), in Europe, on average 40.6/100,000 inhabitants, in Asia 45.9/100,000 inhabitants and in Australia 51.1/100,000 inhabitants per year. According to Kiguchi et al. (2020), the most affected age group is between 64 and 79 years old, most of them male [2-4].

The identification and early intervention of circulatory collapse are of fundamental importance in clinical practice, as they are directly related to increased patient survival. In this sense, the adoption of care protocols such as Basic Life Support (BLS) and Advanced Life Support (ALS), developed by the American Heart Association/International Liaison Committee on Ressuscitation (AHA/ILCOR) [5], make it possible not

only to standardization of care and the improvement of CPR, but also the reduction of morbidity among these patients.

In the occurrence of CA, some factors are determinant in its evolution, namely: initial heart rate, location of the event (infirmary versus emergency unit), time of occurrence and absence of a witness. Among these factors, the assessment of the initial heart rhythm consists of an objective variable, which must be carefully identified by the professional who will conduct this service.

In order to identify the possible cause of CA and provide adequate management of the case, cardiac monitoring of the patient should be initiated. The electrocardiographic rhythms detected on cardiac monitors allow them to differentiate between ventricular fibrillation (VF), pulseless ventricular tachycardia (VT), pulseless electrical activity (PEA), also called electromechanical dissociation (EMD), and asystole. The rhythms of VF and pulseless VT are called shockable rhythms and their primary treatment is electrical defibrillation, whereas those of PEA and asystole are called non-shockable rhythms and the appropriate approach is based on reversing the underlying cause (Fig. 1) [5].

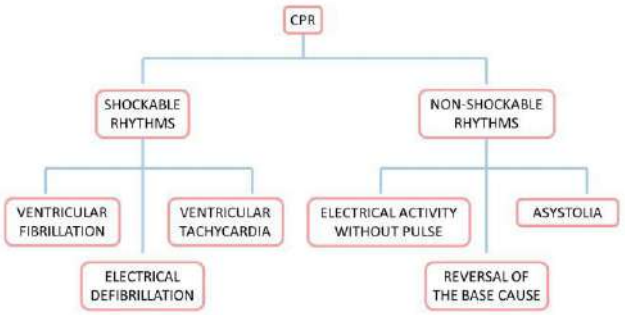

Fig. 1 – Classification of cardiorpulmonary arrest

CPR, Cardiopulmonary resuscitation.

Faced with a situation of shock with reduced cardiac output associated with a reduction or absence of central arterial pulse, there may be an erroneous classification of the cause of CA and consequent inadequate pharmacological and/or mechanical intervention, with an unfavorable outcome for the patient. In addition, a lot of time can be wasted in evaluating the pulse in a patient on PEA, delaying chest compressions and reversal of the underlying cause.

In this scenario, echocardiography (ECHO) allows real-time recognition of myocardial movement, classifying this situation as PEA or pseudo-PEA. Both situations evolve with absence of pulse, but while myocardial contractility is absent in PEA even in the face of coordinated electrical impulse, pseudo-PEA can lead to ventricular myocardial contraction or detectable pressure in the aorta [6].

The early distinction between PEA and pseudo-PEA is necessary, as they have different management and prognosis. This is because pseudo-PEA, if not treated immediately, can progress to PEA, with total cessation of mechanical activity associated with more severe electrolyte and metabolic disturbances. This fact becomes especially relevant due to the increase in CA due to non-shockable causes and, also, the higher incidence of pseudo-PEA (Fig. 2) [7].

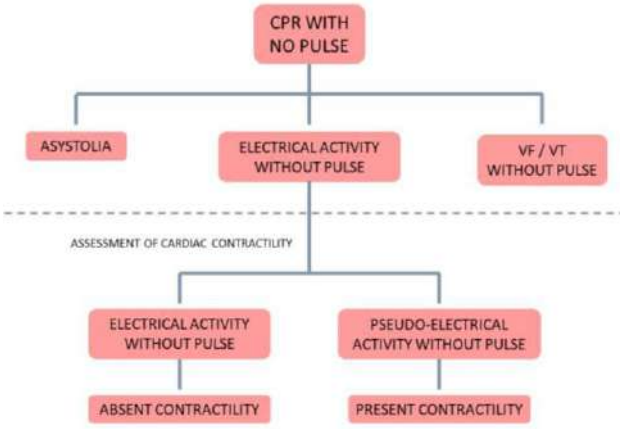

Fig. 2 – Dichotomization of pulseless electrical activity

CPR, Cardiopulmonary resuscitation; VF/VT, ventricular fibrillation/ventricular tachycardia.

As for the possible causes or aggravating factors of CA, they can be divided into cardiac and non-cardiac. Cardiac ones are more common (50-60%) [2], such as arrhythmia, myocardial infarction, heart failure. Among the non-cardiac causes, the most prevalent cause is respiratory failure (15-40%) [2], but, in general, they are synthesized in the 5Hs (Hypovolemia, Hypoxia, Hypothermia, Hydrogen ion – metabolic acidosis and hypo/hyperkalemia) and 5Ts (Cardiac tamponade, pulmonary thromboembolism, coronary thrombosis, tension – hypertensive and toxic pneumothorax) [2,5], with adequate treatment for each cause (Table 1). Early identification of the cause can improve the patient's prognosis.

Table 1 – Main causes of cardiopulmonary arrest and its treatments

Cause		Treatment
5 Hs		
	Hypovolemia	Volume replacement, blood products, stop bleeding
	Hypoxia	Oxygen supply
	Hypothermia	Rewarming
	(acidosis)	Sodium bicarbonate
	H's	Hypokalemia: intravenous potassium chloride
		Hyperkalemia: intravenous calcium gluconate, sodium bicarbonate and/or polarizing solution
5 Ts		
	Tamponade (cardiac)	Pericardiocentesis
	Thrombosis (pulmonary)	Fibrinolytic
	Thrombosis (coronary)	Primary angioplasty
	Tension (pneumothorax)	Thoracic drainage
	Toxins	Specific antagonist

The use of echocardiography as a diagnostic tool in the world of emergency and intensive care has been developing over the last 10 years, with a growing number of publications. The relevance of the theme is related to the improvement in the care of critically ill patients and aid in decision-making by the health professional, considering the trinomial: problem, critically ill patient and echocardiography. These aspects resulted in the expression "ultrasound at the point of care" (Point of Care Ultrasound - POCUS) (Fig. 3) [8].

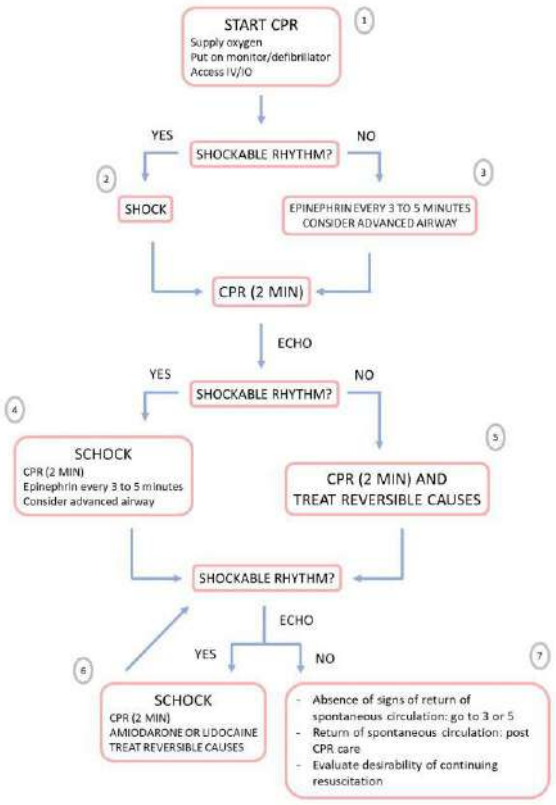

Fig. 3 – Insertion of the ECHO in the CA

CPR, Cardiopulmonary resuscitation; IV/IO, intravenous vascular access/intraosseous vascular access; ECHO, Echocardiography.

POCUS is an imaging diagnostic modality used for a wide range of purposes, both in the emergency room, as well as in intensive care units and perioperative environments. This tool has defined, in recent years, a paradigm shift in the provision of care and management of critically ill patients, as it allows for an accessible, quick and targeted assessment of the patient. In addition, it allows for a patient-centered approach, as it is performed at the bedside (at the point of care), adding physical examination to real-time technology, and, in the case of patients undergoing CA, ECHO can be performed in the transthoracic (TTE) or transesophageal (TEE) modalities [8,9].

The short and long parasternal axis, apical 4-chamber and subxiphoid views are visible at TTE. In turn, TEE is performed in intubated patients, by inserting a probe into the esophagus, and allows the visualization of the 4-chamber mid-esophageal region, mid-esophageal axis and transgastric vision [8].

Although the latest American Heart Association guideline invalidates POCUS as a prognostic tool (Class 3: No Benefit), it points to the use of echocardiography in

identifying the potential reversible cause of CA or detection of return of spontaneous circulation (Class 2b: Weak). However, this aspect was not reassessed for 2020, with the latest evidence compiled in 2015 [5,10]. In contrast, the latest CPR guide from the European Resuscitation Council supports the idea that the use of the POCUS helps to identify reversible causes, with reservations about the pauses in chest compressions, indicating the use of TEE, which allows continuous imaging without interfering with resuscitation movements [11].

Thus, given the importance of correctly identifying the cause of CA to promote adequate treatment for the patient and increase their survival and how ECHO can help in this critical moment, this article aims to present an update of the scientific evidence about the use of ECHO during the CA.

II. METHOD

Integrative literature review, which covered theoretical and practical concepts of the use of ECHO during CA. This approach allows researchers to gather scientific evidence and contextualize it, in order to elucidate their respective applicability. It can be carried out from experimental and non-experimental studies, in addition to theoretical and empirical literature, in order to support the reader in understanding the phenomenon studied. [12].

The six steps suggested by Souza et al. [12] were followed in this research: 1) elaboration of the guiding question; 2) search or sampling in the literature; 3) data collection; 4) critical analysis of the included studies; 5) discussion of results and 6) presentation of the integrative review.

The guiding question adopted for this study was elaborated based on the PICO strategy — an acronym in English for Population (P), Intervention (I), Comparison (C) and Outcome (O). Thus, in the present study, it was established: P – patients in CA; I – use of ECHO; C – use of ECHO with or without comparison; and O – advantages and disadvantages. The guiding question adopted was: What is the current scientific evidence on the advantages and disadvantages of using ECHO in patients during CA?

The search in the literature was performed using the descriptors "Echocardiography" and "Cardiac Arrest", according to the Medical Subject Headings (MeSH), together with the database with the greatest possibility of containing scientific material, relevance and level of worldwide evidence, on the information required, namely, Medical Literature Analysis and Retrieval System Online (Medline). Studies were considered eligible if: original and available in full, answered the study question, had an adult population sample (> 18 years old) and published between 2019 and 2021, with a view to including more contemporary articles. Theoretical reflection articles, reviews and editorials were excluded, as well as those dealing with traumatic CA.

Initially, 253 articles were identified. After screening the authors, by reading the title and abstract, and, confirming the inclusion, read it in full. Subsequently, from the full analysis, the final sample consists of 8 articles (Fig. 4).

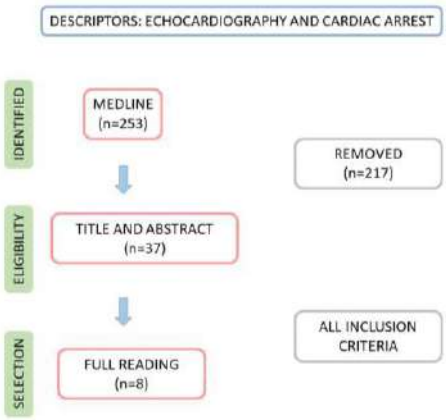

Fig. 4 – Article selection flowchart for review

The search in the database was performed by one of the authors and the critical analysis of titles and abstracts, separately by three of the authors, who later met and compared their impressions. In cases of disagreement, a fourth reviewer was consulted, until consensus was reached, considering the purpose of this review.

For data collection, the authors performed the full reading of the eligible articles and, from a script containing the article title, journal, year of publication, authors, country of origin, objective, study design, number of participants, average age, ECHO positioning, operator, training, initial rhythm and main results, carried out their critical analysis. Next, a consensus was reached, leading to the definition of the articles to be analyzed in this review.

The categorization of data extracted from selected articles into thematic areas was then carried out, through the identification of common variables, and the presentation of results and discussion in a descriptive manner.

III. RESULS AND DISCUSSION

Use of TTE during CA

A prospective observational OH [13], with 32 patients, and a cross-sectional IH and OH study [14], with 9, reported the use of TTE during CA. Both performed the procedure in adults with PEA and the rescuer was a medical professional.

In addition to enabling the visualization of moving heart chambers and valves, synchronized with CPR, the use of TTE was strongly correlated with the level of end-tidal carbon dioxide ($EtCO_2$) induced by resuscitation maneuvers [13]. According to the study authors, the relevance of this finding lies in the fact that, when analyzing this non-invasive measure (lateral flow technique), hemodynamic-guided CPR can be performed, since the $EtCO_2$ levels during CPR reflect pulmonary blood flow and cardiac output. Such parameters can even guide the positioning of the rescuer's hands, which are placed in the lower half of the sternum, without considering individual morphophysiopathological changes, which can potentially affect the hemodynamic effect of CPR [15] (Table 2).

In this sense, it is noted that the personalization of CPR through TTE can increase the hemodynamic efficacy of CPR, the rate of return of spontaneous circulation and survival, in addition to having been considered a promising non-invasive tool for patients undergoing CA. However, as the study itself suggests, it is necessary to verify whether this parameter is applicable to all resuscitated patients [13].

Studies have associated the $EtCO_2$ value above 25 mmHg with the return of spontaneous circulation and, consequently, with survival. Thus, its use could help predict the patient's prognosis as well as decision-making regarding the continuation of resuscitation efforts [16,17].

Through TTE, Miyazaki et al. [14] identified that it is possible to detect right ventricular overload, indicative of pulmonary embolism. From that, it was possible to institute the required treatment, which gave rise to ECMO CPR (extracorporeal veno-arterial membrane oxygenation).

Table 2 – Use of transthoracic echocardiography during cardiopulmonary arrest

Study	Design	No.	Initial rhythm	Main results
Skulec et al. [13]	Prospective observational	32	PEA	Positive relationship between compression and expired CO_2 levels (non-invasive measure)
Miyazaki et al. [14]	Cross-sectional	9	PEA	The discovery of right ventricular overload by TTE led to the suspicion of pulmonary embolism, influencing the decision to use extracorporeal veno-arterial membrane oxygenation

TTE, transthoracic echocardiography; PEA, pulseless electrical activity.

Cardiac tamponade, right ventricular distension indicative of pulmonary embolism, hypovolemia, ventricular arrhythmia, and aortic emergencies are examples of accurate diagnoses possible with the use of TTE. When it allows for adequate visualization of the heart, it directs the position of the rescuer's hands over the left ventricle (hemodynamic improvement and higher rate of circulation return and survival) [18,19].

However, Teran et al. [20] carried out a review on the use of TTE during CPR and found the difficulty to obtain interpretable images as a limitation of its use. To this, they linked external and patient-related factors, such as continuous chest compression, positive pressure ventilation, obesity and stomach air, which contribute to challenging images to interpret. For this reason, the use of TTE is being increasingly sought after.

Use of TEE during CA

Of the selected articles, four dealt with the use of TEE during CA: two observational OH studies, one with 33 patients [21], and the other with 22 [22], and two control cases: one with 22 patients, which included events of CA IH and OH [23], and another with 25, performed in the IH environment [24]. In these articles, CPR was performed by emergency physicians and only one specified the heart rate (not shockable) [21].

The studies showed that, by using TEE, it was possible to explore the blood flow mechanism through the opening

and closing of the mitral valve and the tricuspid, to identify the type of myocardial activity as well as the reversible causes during CPR compressions [21,22]. Through TEE, for example, ventricular fibrillation was identified, which resulted in defibrillation, ventricular dysfunction [21], and aortic dissection [23], conducted with specific management, but which is associated with unsatisfactory outcome CPR.

In addition, TEE allowed for optimal CPR placement of the hands or mechanical device during ventricular compression. Despite being invasive, the adoption of this practice was evaluated as useful to optimize compressions and guide invasive and homodynamic treatments [21]. It was also identified that the pause of compressions during CA is smaller with the use of TEE compared to TTE [24] (Table 3).

Table 3 – Use of transesophageal echocardiography during cardiopulmonary arrest

Study	Design	No.	Initial rhythm	Main results
Fair et al. [24]	Case-control	25	Not specified	The pause of compressions during cardiopulmonary arrest is smaller with the use of the TEE compared to the TTE
Kim et al. [22]	Prospective observational	22	Not specified	The dynamics of heart compression can be measured by analyzing TEE images of the right ventricle
Teran et al. [21]	Prospective observational	33	Not specified	Characterization of cardiac activity
Kim et al. [23]	Case-control	45	Not specified	TEE is a useful tool for diagnosing aortic dissection as a cause of cardiac arrest during CPR. This condition is associated with poor resuscitation results.

TEE, transesophageal echocardiography; TTE, transthoracic echocardiography; CPR, cardiopulmonary resuscitation.

A prospective cohort study [25], carried out with 40 emergency medical residents, evaluated their ability to learn and practice, in a simulated environment, TEE image acquisition techniques to identify common pathological causes of cardiac arrest as highly precise and accurate. Regardless of external or patient-related factors, TEE is capable of providing continuous, reliable and high-quality myocardial images, which allow for feedback and, in turn, immediate adjustments, aiming at the quality of CPR. Thus, it has a diagnostic and prognostic role similar to TTE, but it does not interrupt chest compressions and provides imaging advantages [20,26].

Recognizing that high-quality cardiac compressions and less interruption in CPR corroborate with increased survival and better neurological outcomes, TEE has been used in environments such as the emergency room and intensive care units (ICU). However, it should be noted that it consists of a semi-invasive procedure, contraindicated for patients with oroesophageal lesions (such as trauma or tumor), recent gastrointestinal (GI) surgery, active GI bleeding, severe coagulopathy, for example [27]. Furthermore, a prospective study carried out in 28 medical centers [28] identified a risk of complications (upper gastrointestinal or pharyngeal bleeding; gastroesophageal laceration or esophageal perforation) of 0.08%, that is, 1:1300 examination, followed by death in 0.03%, equivalent to 1:3000, most in patients without risk factors for gastroesophageal injury. Minor complications such as lip, dental and oral lesions; oral bleeding; odynophagia and swallowing dysfunction may also occur. Thus, although safe, there is a low morbidity and mortality rate associated with TEE that should be considered and support the training of emergency physicians.

The use of POCUS during CA

Finally, the remaining two articles did not specify the position of ECHO (TTE or TEE), approaching the subject in general (POCUS). One of the articles was carried out in the IH environment and consists of a cross-sectional study with 180 patients with non-shockable rhythm CA [29]. The other was a prospective observational study, carried out in the OH, with eight patients in asystole [30].

Greater speed in obtaining diagnoses and therapeutic decisions was observed with the use of POCUS [30], but further studies are needed due to possible risk of bias in the results and the scarcity of literary evidence. In addition, it is not yet proven that the use of this tool increases patient survival [29].

As seen in other articles, Beckett et al. [29] identified that it is possible to detect cardiac activity using POCUS and, in these cases, obtaining a better prognosis is more likely, as pre-hospital teams can look for reversible causes before arriving at the hospital service. [30].

When combined with the electrocardiogram (ECG), it has a sensitivity of 96.2% to identify failure to achieve spontaneous venous return, being more effective in predicting negative CPR results than the ECG alone [29] (Table 4).

Table 4 – Use of FOCUS during cardiopulmonary arrest

Study	Design	No.	Initial rhythm	Main results
Javaudin et al. [30]	Prospective observational	8	Asystole	POCUS can reveal reversible CA conditions, allowing adjustment of clinical management
Beckett et al. [29]	Cross-sectional	180	Non shockable rhythm	The use of POCUS, with or without ECG, better predicts negative outcomes in cardiac arrest than ECG alone.

ECG, electrocardiogram; CA, cardiopulmonary arrest; POCUS, point of care ultrasound.

When it comes to POCUS during CA, studies show that its use has expanded, with applications that include valve assessment, diastolic dysfunction and wall motion abnormalities, in addition to helping in the diagnosis of cardiovascular conditions that can cooperate with shock, such as left ventricular failure and right ventricular dilatation [31].

However, handling this tool has been associated with a significant increase in the time of pulse checks during CA, nearly doubling the maximum 10-second duration recommended in current guidelines. In this sense, it is essential that health professionals are aware of this factor and are trained to apply the POCUS with a view to improving CPR, since the time factor is non-negotiable for these patients [32,33].

IV. FINAL CONSIDERATIONS

The cardiac images provided by POCUS make it possible to assess the movement of cardiac chambers and valves, blood flow and myocardial contractility. From this, the rhythm can be classified as shockable, where the main treatment is electrical defibrillation, or non-shockable, in which the treatment consists of reversing the underlying cause, with ECHO helping to identify many of these causes. That is, you can start the appropriate treatment for the patient more quickly and enable a better prognosis.

According to the data, in addition to visualization of the heart, TTe associated with other monitoring methods, such as $EtCO_2$ (expiratory carbon dioxide levels), corroborate the efficiency of chest compressions and positioning (hemodynamic effectiveness of CPR) the rescuer's hands. However, it interrupts the CPR process and can be limited by conditions related to the patient, such as obesity, for example.

TEE, in turn, allows the visualization of more accurate cardiac images, contributing to more assertive diagnoses. It also helps with hand positioning during CPR, but although it does not interfere with chest compressions, it is an invasive measure. This tool has contraindications and there is a morbidity and mortality rate that, despite being low, should be considered by emergency physicians.

Comparing both, the superiority of TEE over TTE was noted due to its ability to provide constant cardiac images without CA interruption, thus contributing to an early diagnosis and therapeutic decision. However, further studies are needed to confirm whether there is a relationship between the use of POCUS (TTE or TEE) with increased patient survival.

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Use of the ultrasonic transparency technique to calculate the elastic and physical properties of flat glass

Utilização da técnica ultrassônica da transparência para o cálculo de propriedades elásticas e físicas dos vidros planos

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Abstract *— The elastic properties of soda lime silicate float glass were analyzed by transmission technique ultrasonic. Four samples of glass in white, smoked and green color were obtained commercially and investigated with ultrasonic velocities at 125 kHz frequency. As a result, properties such as shear modulus, Young's modulus, bulk modulus, Poisson's ratio, microhardness, acoustic impedance, fractal bond connectivity and anisotropy factor were assessed by longitudinal and transverse velocities data and density measurements in the samples. The results were compared with reference values published in the literature attesting the viability of the proposed method.*

I. INTRODUÇÃO

Os vidros planos, também conhecidos como vidros *float*, têm se destacado no mercado da construção civil devido ao aumento das áreas envidraçadas, que é uma tendência na arquitetura moderna. Entretanto, o aumento das áreas envidraçadas tem causado diversos questionamentos sobre a segurança e o aumento da temperatura interna nas edificações, que por sua vez, provoca um maior consumo de energia elétrica com o uso de equipamentos de refrigeração.

O vidro *float* é definido como sendo um vidro de silicato sodacálcico, plano, transparente, incolor ou colorido em sua massa, de faces paralelas e planas, que se obtém por fundição contínua e solidificação no interior de um banho de metal fundido [1]. Além de serem bastante utilizados na construção civil, eles servem como base para a obtenção de diversos tipos de vidros comerciais. As composições químicas dos vidros *float* incolor (*white ou clear glass*), fumê (*smoked ou grey glass*) e verde (*green glass*) são semelhantes e bastante conhecidas, sendo encontradas apenas pequenas variações nos principais elementos constituintes, quais sejam: 68-75% SiO_2, 0-4% Al_2O_3, 6-12,4 % Na_2O, 0-3% K_2O, 10,2-17% CaO e 0-5,5% MgO [2-6].

Geralmente, o vidro plano incolor apresenta baixos percentuais de Fe_2O_3 ou a ausência desse óxido entre os seus principais elementos constituintes. Entretanto, adições percentuais entre 0,25% e 0,65% de Fe_2O_3 podem favorecer a coloração do vidro fumê [4, 6, 7]. Por outro lado, uma coloração esverdeada pode ser obtida mantendo a faixa percentual de Fe_2O_3 e adicionando percentuais em torno de 1% de CeO_2 e 1% de TiO_2 [3]. Além disso,

percentuais entre 0,002% e 0,06% de CrO_2 também são responsáveis pela coloração esverdeada de alguns tipos de vidros [8].

As variedades na coloração do vidro plano permitem o seu uso em situações onde se deseja reduzir a entrada de luz nas edificações, além de controlar a radiação solar, uma vez que parte da radiação será refletida para o ambiente externo e a outra parte será absorvida pelo vidro.

É importante conhecer algumas propriedades dos vidros planos, tais como, resistência à flexão, dureza, resistividade elétrica e absorção óptica. Isto porque, essas propriedades fornecem informações importantes sobre desempenho desses vidros em diferentes situações de uso [9, 10-12]. Contudo, o conhecimento dessas propriedades ainda é insuficiente para caracterizar os vidros planos de forma mais abrangente. Por exemplo, existe uma recomendação normativa para que também sejam realizados ensaios de análise dimensional, resistência ao choque mecânico, resistência ao choque térmico, fragmentação e ensaio de segurança [13].

A maioria dos ensaios mecânicos para caracterização dos vidros planos são destrutivos, ou seja, danificam ou inutilizam as amostras investigadas. Além disso, estes ensaios demandam maior tempo e custo para aquisição dos resultados, devido à necessidade de produzir várias amostras que serão investigadas por diferentes ensaios. Uma alternativa que poderia reduzir o tempo e os custos gerados com ensaios convencionais consiste na utilização de ensaios não destrutivos. Esses ensaios utilizam técnicas capazes de inspecionar e caracterizar um material sem a necessidade de destruí-lo [14].

Os ensaios não destrutivos são bastante utilizados para o estudo das propriedades elásticas dos materiais, sendo o ensaio por ultrassom uma das técnicas mais conhecidas e aplicadas na investigação de vidros [15-17]. A maior vantagem no uso do ensaio por ultrassom está na possibilidade de estimar diversas propriedades elásticas e físicas, que podem ser descritas em função da densidade e dos valores das velocidades de propagação de ondas ultrassônicas de modo longitudinal e transversal [18]. Este fato evidencia a vantagem no uso do ultrassom, que pode ser utilizado para caracterizar os vidros planos de forma rápida, dispensando a necessidade de realização dos ensaios mecânicos convencionais.

Portanto, com base nos aspectos abordados acima, este estudo buscou desenvolver uma metodologia de ensaio não destrutivo, que utiliza a propagação de ondas ultrassônicas para caracterizar propriedades elásticas e físicas dos vidros planos aplicados em janelas e nos fechamentos dos ambientes internos das edificações.

II. MATERIAIS E MÉTODOS

2.1 Características das amostras de vidro

Para a realização deste estudo foram adquiridas quatro amostras de vidro de janela, fornecidos por uma vidraçaria comum, sendo uma amostra incolor (IG), uma fumê claro (FN), uma fumê escuro (FI) e outra de coloração esverdeada (VM). Os vidros planos ou do tipo *float*, apresentavam superfícies lisas e livres de falhas ou trincas. A massa dos vidros foi medida com uma balança digital de resolução igual a 0,01 g e suas dimensões foram aferidas com um paquímetro com resolução de 0,005 mm. O volume das amostras foi calculado pelo produto, comprimento (c) x largura (l) x espessura (e). Na Tabela 1 estão apresentadas as dimensões das amostras de vidro, bem como seus respectivos valores de massa e volume.

Tabela. 1: Massa e volume das amostras de vidro

Vidro	Massa (kg)	*c* (m)	*l* (m)	*e* (m)	Volume ($10^{-5}m^3$)
IG	0,207	0,2200	0,1050	0,0036	8,3160
FN	0,191	0,2000	0,0997	0,0036	7,1784
FI	0,195	0,1999	0,0998	0,0037	7,3815
VM	0,193	0,1998	0,1000	0,0035	6,9930

A densidade (ρ) dos vidros foi calculada utilizando a Equação 1, que consiste na razão entre a massa (m_{vidro}) e o volume (V_{vidro}). O valor calculado da densidade foi admitido como uniforme, uma vez que foram consideradas amostras com inércia constante e distribuição de massa homogênea.

$$\rho = m_{vidro}/V_{vidro} \quad (kg/m^3) \qquad (1)$$

2.2 Instrumentação para medidas dos sinais ultrassônicos

Para medir os sinais ultrassônicos propagados através dos vidros foram desenvolvidos dois circuitos eletrônicos, sendo um deles emissor e o outro receptor de sinais. O circuito emissor é constituído por um oscilador, um gerador de pulsos e um amplificador de pulsos. Esse circuito produz pulsos com amplitude de 100 V e duração de 1 μs, em intervalos de tempo iguais a 1 s. Os pulsos aplicados em um transdutor piezoelétrico com diâmetro de 0,02 m, geram ondas ultrassônicas longitudinais com frequência de 125 kHz. O circuito emissor de ondas ultrassônicas possui uma fonte de alimentação que fornece tensões de +5 V, +12 V e +100 V.

O circuito receptor é constituído por um amplificador operacional, um filtro passa-baixa e um filtro passa-alta. Esse circuito amplifica e filtra o sinal captado por outro transdutor piezoelétrico, do mesmo tipo utilizado no

circuito emissor, fornecendo na saída o sinal medido com um osciloscópio utilizado como instrumento externo. A fonte de alimentação desse circuito fornece tensões de +5 V e -5 V. Um osciloscópio digital, da marca Tektronix, modelo TBS1062, foi conectado a um computador para exportação dos dados utilizando o programa OpenChoice Desktop. Dessa forma, foi possível determinar a diferença entre o tempo da onda ultrassônica emitida e recebida.

Na Figura 1 estão apresentados os circuitos eletrônicos, emissor e receptor, utilizados para propagar as ondas ultrassônicas longitudinais através dos vidros investigados. As medidas foram realizadas com os tradutores posicionados nas extremidades dos vidros, conforme ilustra os exemplos nas Figuras 1(a) e (b) para os vidros incolor (IG) e fumê escuro (FI), respectivamente. O mel de abelha foi utilizado como acoplante entre os transdutores e a superfície dos vidros. O tempo de percurso, em microssegundos (μs), entre a onda ultrassônica emitida e recebida através dos vidros, está ilustrado na Figura 2. O comprimento adotado entre os centros dos transdutores foi de 0,18 m, sendo este valor admitido como a distância percorrida pela onda ultrassônica através das amostras.

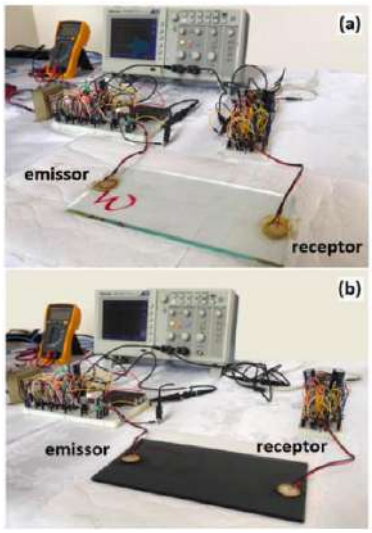

Fig. 1: Circuitos eletrônicos emissor e receptor de ondas ultrassônicas: (a) medidas no vidro incolor e (b) no vidro fumê escuro

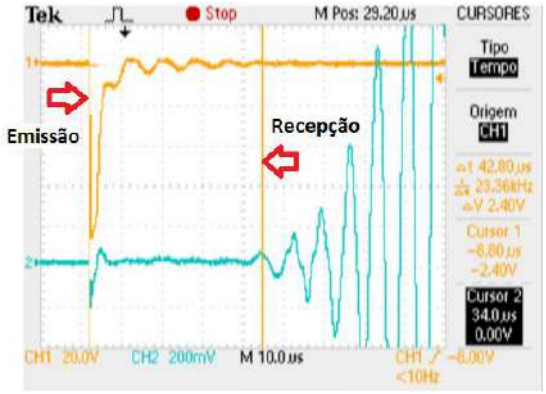

Fig. 2: Determinação do tempo de percurso da onda ultrassônica através dos vidros utilizando o programa OpenChoice Desktop

A velocidade de propagação da onda longitudinal (V_L) foi calculada utilizando a Equação 2, que representa a razão entre a distância percorrida pela onda ultrassônica (c) e o tempo de percurso (t). O valor de V_L foi obtido a partir da média de três medidas reprodutíveis, que foram realizadas com a remoção e o reposicionamento dos transdutores nas extremidades dos vidros.

$$V_L = c/t \quad \text{(m/s)} \tag{2}$$

Para estimar o valor da velocidade transversal (V_T) foram analisadas as relações existentes entre V_L e V_T para diferentes tipos de vidros. Para os vidros sodacálcicos, a razão entre V_T e V_L está em torno de 0,60 [5, 7, 19]. Este resultado também é observado em vidros de telúrio, de chumbo, de zircônia ou de boro, e também em vidros de sílica fundida [17, 19-21]. Portanto, a partir da velocidade longitudinal (V_L) foi estimada a velocidade da onda ultrassônica transversal (V_T) por meio da Equação 3.

$$V_T = 0{,}60 V_L \tag{3}$$

2.3 Cálculo das propriedades dos vidros

Nos vidros isotrópicos algumas propriedades elásticas, tais como, os módulos de elasticidade (E), cisalhamento (G), compressibilidade (B) e o coeficiente de Poisson (v), podem ser descritas em função do valor da densidade (ρ) e das velocidades ultrassônicas de modo longitudinal (V_L) e transversal (V_T) [20-22]. Entre as propriedades físicas que podem ser estimadas com ondas ultrassônicas destacam-se: o coeficiente de expansão térmica (α), a impedância acústica (Z), a microdureza (H), o fator de anisotropia (A) e o parâmetro *fractal bond connectivity* (F), que relaciona as propriedades elásticas dos vidros à sua estrutura atômica [15, 17, 23-27]. Assim, as propriedades elásticas e físicas foram avaliadas utilizando as equações apresentadas na Tabela 2.

Tabela. 2: Propriedades dos vidros em função das velocidades ultrassônicas

N°	Propriedade	Equação
4	Módulo de elasticidade (*GPa*)	$E = \rho V_T^2 \left(\frac{3V_L^2 - 4V_T^2}{V_L^2 - V_T^2} \right)$
5	Módulo de cisalhamento (*GPa*)	$G = \rho V_T^2$
6	Módulo de compressibilidade (*GPa*)	$B = \rho \left(\frac{3V_L^2 - 4V_T^2}{3} \right)$
7	Coeficiente de Poisson	$\nu = \frac{V_L^2 - 2V_T^2}{2(V_L^2 - V_T^2)}$
8	Microdureza (*GPa*)	$H = \frac{(1-2\nu)E}{6(1+\nu)}$
9	Coeficiente de expansão térmica (K^{-1})	$\alpha = 23{,}2(V_L - 0{,}57457)$
10	Impedância acústica ($kg.m^{-2}s^{-1}$)	$Z = \rho V_L$
11	*Fractal bond connectivity*	$F = \frac{4G}{B}$
12	Anisotropia elástica	$A = \left(\frac{2C_{44}}{C_{11} - C_{12}} \right)$

Para o cálculo da anisotropia as constantes elásticas apresentadas na Equação 12 podem ser descritas em função das velocidades ultrassônicas e da densidade dos vidros, em que: $C_{11} = \rho V_L^2$, $C_{44} = \rho V_T^2$ e $C_{12} = C_{11} - 2C_{44}$ [18].

III. RESULTADOS E DISCUSSÃO

3.1 Propriedades elásticas das amostras de vidro

Na Tabela 3 estão as propriedades elásticas obtidas com as Equações de 4 a 7. Analisando os resultados nota-se que os módulos de elasticidade (*E*), cisalhamento (*G*) e compressibilidade (*B*), são um pouco menores para o vidro incolor (IG), quando comparados com os valores encontrados para os vidros fumê claro (FN), fumê escuro (FI) e verde (VM). Os valores das propriedades *E*, *G* e *B*, sugerem que o vidro incolor apresenta uma menor rigidez às deformações longitudinal, transversal e volumétrica, respectivamente. Este fato pode estar associado, sobretudo, aos baixos percentuais ou à ausência dos elementos Fe_2O_3 e Cr_2O_3 nos vidros incolores, cujas concentrações desses elementos são maiores nos vidros fumê e verde, respectivamente [4, 6, 8, 28].

Com exceção do coeficiente de Poisson (*v*), os valores encontrados de *E*, *G* e *B* foram inferiores àqueles relatados na literatura para os vidros sodacálcicos comerciais. Um estudo realizado em vidros sodacálcicos com baixos percentuais de Fe_2O_3 e com ausência de ZnO, revelou que os valores das propriedades elásticas podem apresentar algumas variações. Por exemplo, o módulo *E* pode variar entre 70,70 GPa e 75,60 GPa, o módulo *G* entre 29,40 GPa e 31,20 GPa, e o módulo *B* entre 39,50 GPa e 43,90 GPa [6]. Para o coeficiente *v* são encontrados valores entre 0,20 e 0,22 [6]. Portanto, os resultados apresentados na Tabela 3 indicam que as amostras possuem propriedades elásticas inferiores aos dos vidros sodacálcicos com baixos percentuais de Fe_2O_3 e ausência de ZnO.

A presença do ZnO pode influenciar na velocidade de propagação ultrassônica, na densidade e em algumas propriedades dos vidros sodacálcicos [7]. Por exemplo, em vidros sodacálcicos com ausência de ZnO o valor de V_L está torno de 4956 m/s, mas com adições de 5% e 39% desse óxido, o valor de V_L diminui para 4836 m/s e 3541 m/s, respectivamente [5]. Assim, os valores mais baixos de V_L encontrados nas amostras podem estar associados a presença do ZnO em suas composições.

No que se refere a densidade, em geral, o vidro sodacálcico apresenta densidade em torno de 2500 kgf/m^3 [29]. Entretanto, adições de ZnO influenciam nas variações percentuais nos principais elementos químicos, resultando em valores de densidade entre 2522 kgf/m^3 e 2738 kgf/m^3 [30]. Por outro lado, a utilização de Cr_2O_3 para a obtenção da coloração esverdeada também aumenta a densidade dos vidros para valores próximos a 2765 kgf/m^3 [28].

Tabela. 3: Propriedades E, G, B e v para os vidros

Vidro	**ρ (kg/m^3)**	**V_L (m/s)**	**V_T (m/s)**	***E* (*GPa*)**	***G* (*GPa*)**	***B* (*GPa*)**	***v***
IG	2489,18	4736,84	2842,10	49,01	20,11	29,04	0,22
FN	2660,76	4639,18	2783,51	50,25	20,62	29,78	0,22
FI	2641,74	4687,50	2812,50	50,90	20,90	30,18	0,22
VM	2759,90	4591,84	2755,10	51,06	20,95	30,26	0,22

Sabendo que a adição do ZnO altera os valores das velocidades ultrassônicas e da densidade, fica claro que a presença do ZnO também interfere no valor das propriedades elásticas dos vidros. Por exemplo, para vidros sodacálcico com composição química de 55,4%SiO_2, 2,1%Al_2O_3, 10,2%Na_2O, 1,1%K_2O, 9,1%CaO, 1,7%MgO, e 19,7%ZnO, podem ser encontrados valores de E = 51,17 GPa, G = 20,41 GPa e B = 34,57 GPa [5, 7]. Logo, diferente dos resultados apresentados anteriormente para vidros sodacálcicos com baixos percentuais de Fe_2O_3 e com ausência do ZnO, estes valores são semelhantes aos resultados apresentados na Tabela 3. Ressalta-se ainda que a perda nas propriedades elásticas com a adição ZnO é mais acentuada para percentuais em torno de 38,9%. Como consequência, as propriedades elásticas diminuem consideravelmente para E = 25,96 GPa, G = 9,61 GPa e B = 28,71 GPa [5, 7].

Os vidros com ZnO geralmente são obtidos a partir da mistura de garrafas moídas, que são homogeneizadas com ZnO na forma particulada para posterior fundição e moldagem [7]. Além da obtenção de vidros sodacálcicos a partir da reciclagem de garrafas, outra finalidade na adição do ZnO está no aumento da absorção óptica [9]. Dessa forma, analisando os valores de densidade e das propriedades elásticas apresentadas na Tabela 3, acredita-se que as amostras investigadas no presente estudo possam apresentar percentuais de ZnO em sua composição. Contudo, é importante destacar que essa hipótese está fundamentada nos relatos encontrados na literatura sobre a composição química geral dos vidros sodacálcicos incolor, fumê e verde, e apenas pode ser comprovada por meio de uma análise química dos elementos constituintes das amostras.

Os valores das propriedades elásticas E, G e B obtidos nas amostras também são semelhantes àqueles observados em alguns vidros comerciais a base de telúrio (ZnO-AlF_3-TeO_2) com adição do ZnO. Por exemplo, em vidros de telúrio com 25% de ZnO podem ser observados valores de E = 50,60 GPa, G = 20,51 GPa e B = 31,64 GPa [20].

3.2 Propriedades físicas das amostras de vidro

Na Tabela 4 encontram-se as propriedades físicas das amostras calculadas com as Equações de 8 a 11. De maneira geral, os valores de microdureza (H) representam a resistência à deformação plástica dos vidros. O vidro incolor (IG) apresentou o menor valor de microdureza (H = 3,749 GPa), enquanto que o maior valor foi observado no vidro verde (VM) (H = 3,906 GPa). Para os vidros fumê claro (FN) e fumê escuro (FI) foram encontrados valores intermediários de H = 3,844 GPa e H = 3,894 GPa, respectivamente.

Comparando a microdureza com as propriedades elásticas, nota-se que H cresce com os valores de E, G e B. Este resultado está de acordo com o esperado, uma vez que a microdureza geralmente é maior nos vidros com maior rigidez, sendo esse comportamento uma tendência observada não apenas nos vidros sodacálcicos, mas também em outros tipos de vidro [7, 16, 21, 25]. Na Figura 3 estão apresentados os valores das propriedades elásticas E, G e B em função dos valores de H. No resultado é possível constatar que as propriedades elásticas aumentam linearmente com o aumento da microdureza, conforme observado pelos valores dos coeficientes de correlação linear (R^2) que estão próximos de 1.

Tabela. 4: Propriedades físicas H, α, Z e F dos vidros

Vidro	H (GPa)	α ($10^5 K^{-1}$)	Z ($10^6 kgm^{-2}/s$)	F	A
IG	3,749	1,099	11,790	2,770	1,039
FN	3,844	1,076	12,344	2,769	1,039
FI	3,894	1,087	12,383	2,770	1,039
VM	3,906	1,065	12,673	2,769	1,039

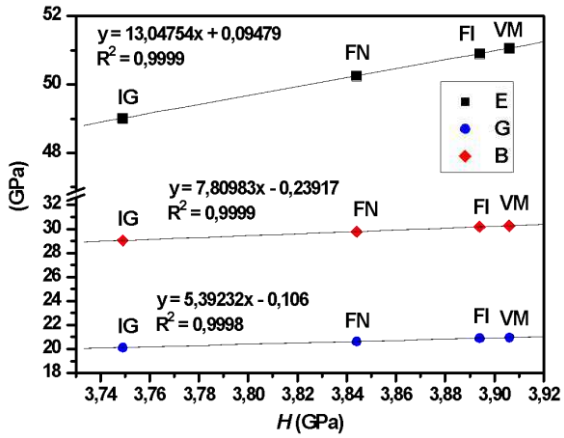

Fig. 3: Propriedades elásticas E, G e B em função de H

A Equação 9 pode ser utilizada para calcular o valor do coeficiente de expansão térmica (α) dos vidros em K^{-1} [25]. Os valores calculados de α representam a variação das dimensões dos vidros em relação às dimensões iniciais a cada K (Kelvin) de variação térmica. Neste caso, o vidro incolor (IG) com valor de α_{IG} = 1,099 x $10^5 K^{-1}$ será mais expansivo, enquanto que o vidro verde (VM), com α_{VM} = 1,065 x $10^5 K^{-1}$, deverá ter suas dimensões menos influenciadas com elevações de temperatura. Dessa forma, os vidros fumê claro (FN) e fumê escuro (FI) devem apresentar expansibilidades térmicas intermediárias entre as dos vidros incolor (IG) e verde (VM), considerando os

valores de α_{FN} = 1,076 x 10^5K^{-1} e α_{FI} = 1,087 x 10^5K^{-1}, respectivamente. Os coeficientes de expansão térmica calculados para os vidros de janela estão próximos do valor médio encontrado em vidros de boro dopados com diferentes percentuais de chumbo (Na_2CO_3-PbO-B_2O_3), que é de α = 1,1 x 10^5K^{-1} [25]. Adicionalmente, nos vidros de boro, a substituição do Pb por diferentes percentuais de ZnO aumenta o valor médio do coeficiente de expansão térmica para α = 1,2 x 10^5K^{-1} [25].

A impedância acústica (*Z*) pode ser compreendida como sendo a oposição à passagem das ondas sonoras através de um material [31]. Na Tabela 4 nota-se que os valores *Z* são maiores para os vidros com maior valor de *H*. Entretanto, os valores de *Z* não apresentam de forma clara uma relação com os coeficientes α. Esse comportamento pode ser mais bem observado analisando os dados apresentados na Figura 4.

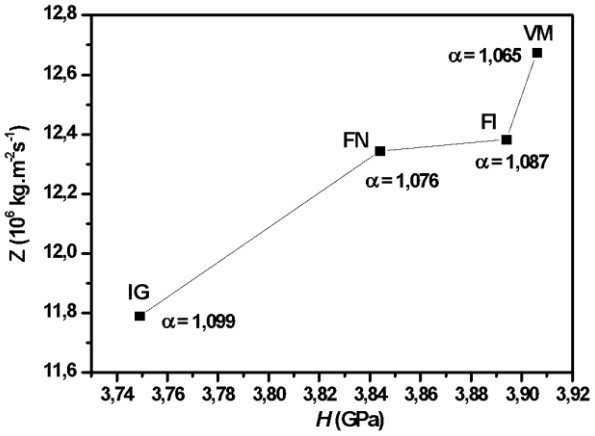

Fig. 4: Valores de Z e α em função de H

Em alguns vidros sodacálcicos os valores de *Z* crescem com os valores de *H*, que por sua vez está associado ao aumento dos módulos *E* e *G* [27]. Esta tendência concorda com os resultados apresentados nas Figuras 3 e 4 para as amostras. Entretanto, outros autores observaram um comportamento diferente nos vidros de boro dopados com ZnO (Na_2CO_3-ZnO-B_2O_3), não sendo constatadas relações entre os valores de *Z* e *H* [25].

Embora os vidros de janela não tenham apresentado uma relação clara entre os valores de α e *H*, em vidros de boro e lítio, contendo diferentes concentrações de K_2O e CaO, observa-se uma tendência no aumento dos valores de *Z* e α com o crescimento dos valores de *H* [15]. Logo, o crescimento de *Z* e α com o aumento de *H*, parece ser muito dependente da presença de alguns elementos na composição química dos vidros.

O parâmetro *fractal bond connectivity* (*F*) pode fornecer informações sobre as relações existentes entre as propriedades do vidro e a sua estrutura atômica. No estudo dos vidros, quando *F* = 3, admite-se uma estrutura constituída de poliedros de coordenação tetraédrica em três dimensões. Para *F* = 2, os poliedros de coordenação tetraédrica estão em duas dimensões e de forma unidimensional para *F* = 1 [23]. Todos os valores calculados foram próximos de 3, indicando que as amostras possuem uma estrutura com tendência de poliedros de coordenação tetraédrica em três dimensões.

Em alguns vidros sodacálcicos os valores de *E*, *G* e *H* diminuem com o valor do parâmetro *F* [32]. Um comportamento semelhante foi observado em vidros de boro e lítio, sendo também relatada uma diminuição nos valores de α para menores valores de *F* [15]. Este resultado concorda com os dados apresentados na Figura 5, onde é possível perceber o comportamento entre α e *F* para as amostras.

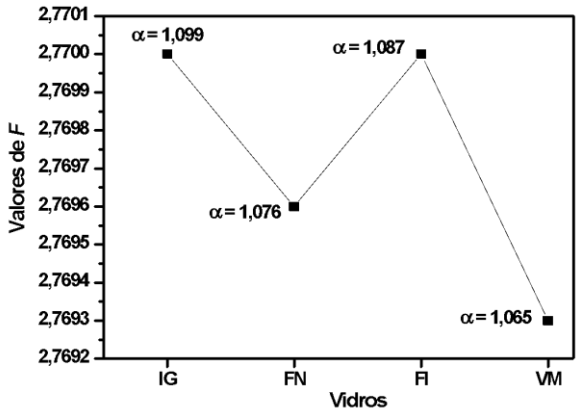

Fig. 5: Relação entre α e F nos vidros de janela

Os valores de anisotropia elástica (*A*) em torno de 1 indicam, teoricamente, que o material não apresenta variações nas propriedades elásticas em função da direção investigada [26, 33]. Neste caso, os valores calculados de *A* = 1,039 para todas as amostras sugerem características isotrópicas. A anisotropia elástica é um importante parâmetro para a caracterização dos vidros planos, pois ao contrário do que se pensa, muitos vidros não são isotrópicos [34].

IV. CONCLUSÃO

Nesse estudo, os resultados encontrados para os módulos de elasticidade (*E*), cisalhamento (*G*) e compressibilidade (*K*), indicaram que os vidros planos podem conter em suas composições químicas a presença

do ZnO, que em determinados percentuais interferem nas propriedades elásticas reduzindo a rigidez. O resultado calculado para o coeficiente de Poisson (v) foi o mesmo para todos os vidros, estando dentro da faixa de valores esperados para os vidros sodacálcicos.

A possibilidade da presença do ZnO na composição química dos vidros planos foi levantada após analisar os resultados de E, G e K, que são inferiores aos valores geralmente obtidos nos vidros sodacálcicos sem adição de ZnO, mas semelhantes àqueles encontrados nos vidros sodacálcicos com percentuais de ZnO em torno de 20%. Outros indicativos que reforçam essa hipótese são os menores valores calculados de V_L e o aumento da densidade, cujas características são esperadas nos vidros sodacálcicos com ZnO.

Os resultados de microdureza (H) foram maiores nos vidros com maior valor de impedância acústica (Z) e maior rigidez, sendo esse comportamento uma tendência observada, não apenas nos vidros sodacálcicos, mas também em outros tipos de vidro. Por outro lado, o coeficiente de expansão térmica linear (α) foi maior nos vidros, cuja estrutura é formada por poliedros de coordenação tetraédrica em três dimensões. Para todos os vidros foram encontrados um valor de anisotropia (A) em torno de 1, indicando que os vidros apresentam características isotrópicas.

A proximidade dos resultados calculados com os valores de referência, associado a um método simples e rápido, atestam a viabilidade de utilização do método ultrassônico da transparência como técnica não destrutiva para caracterização de propriedades elásticas e físicas dos vidros planos.

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The Second Nature in Augustine and Pascal

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Abstract *— This article aims to show that the theme of second nature is central in Augustine and Pascal's thoughts, it is also the foundation of their anthropological reflection that the Bishop of Hippo develops from his researches on the origin of evil while the Jansenist reacts against to rationalist pretensions in the 17th century. We prove how the concept of second nature allows these authors the presentation possibilities of man within a historical-temporal context, considering different social and human cultural issues. It begins at thematic such as the fall and the original sin; Augustine as much as Pascal carries these categories from a theological plan to a context of reason which both thinkers transform in hypothesis for basing current status or after the fall. Thus, Augustine and Pascal give to us a reflection about the human condition in a standard that submits itself neither to fideism nor to rationalism, they set up their anthropological perspectives balancing faith and reason, through this standard analysis.*

I. INTRODUCTION

We can note in Augustine as well as in Pascal's thoughts the effort of justifying theological elements as categories that formed the basis for both authors developing their analysis on the human being. Consequently, these elements are no longer only theological since they perfectly adjust themselves to the rational context. In this work, it concentrates on the second nature which in the Bishop of Hippo and in the Jansenist have as scenario the fall and the original sin according to biblical narrative.

The second nature substantiates itself in the finitude of human existence context that is the current place of our condition which historical and contradictory situation emphasizes. In this scenario are all the human faculties as well as all the constructs that come from their creativity. Hence, these circumstances that are results of the Adamic fall acts as the basis of every political, historical, and philosophical reflection in addition to every scientific development. We can constantly observe, thus, in both authors, theological elements transition, namely, items of faith as the philosophical premises for analyzing the human condition.

Therefore, it uses these biblical categories, such as the fall and the original sin, for Augustine and Pascal, each in their own way, could develop analyses that come out from theological space to anthropological field; and, since the moment in which these categories overcome their place of origin, they get legitimacy within the space of rationality when are applied in the anthropological perspective.

It is important to note that both Augustine and Pascal, despite using the same categories in the human condition analysis, start from different interests. As the Bishop of Hippo responded to the Manicheans and Pelagians, both positions presented different anthropological approaches, with which Augustine held exhaustive debates; the Jansenist thinker reacted, on other hand, to the humanism of the 17th century, especially when it was embodied in

Cartesian rationalism and Molinist theology that the Company Of Jesus adopted.

Throughout this research, we address the anthropology in Augustine, who developed it in many debates and deep analysis, considering as a basis the third chapter narrative from the book of Genesis in which the doctor of grace found through the Adamic fall and the original sin assumptions that are important to his study on the human condition. Subsequently, the article demonstrates the same assumptions in Blaise Pascal's anthropology that exhibits the Bishop of Hippo precedence in the French thinker, however, with this last one included in a new context.

II. THE PROBLEM OF EVIL AND THE SECOND NATURE IN AUGUSTINE

In the fourth century of the Christian era, there were fierce debates about the origin of evil this subject was also absorbed by questions involving human nature. The historical and geographical context marked by the Roman Empire's presence was already freely occupied by religion, which without persecution could develop itself.

During this period, Augustine excelled in lengthy debates with Manicheans and Pelagians that, within the analysis of evil, also included anthropological issues. Already introduced to Greek-Latin philosophical thought, the young Augustine entered his studies with the Manicheans searching for answers to the evil problem and, as a result, he was not satisfied with this solution. Continuing the search for this truth, he ended up converting himself to Christianity. Thereafter, he made use of Greek philosophy, with an apologetic effort, covering it with the Christian faith, which reflects in his anthropology. As Vaz (1991) commented, this anthropology, which consists in the Platonic tradition transposition into the fundamental themes of the biblical and Christian tradition from the previous patristic, was the reference for the medieval conception of man, which influenced Western anthropological thought until our days. Furthermore, it is important to note that the break with Manichaeism was of paramount importance for Augustinian anthropology.

The Manicheans with whom Augustine had contact, in their studies on the origin of evil, saw this issue also through an anthropological perspective, while they conceived man as a being of soul and body, they aimed to prove that these two parts were antagonistic; in other words, evil and good were represented by the body and the soul where the body, the material side was the territory of evil, and the soul, the immaterial side of man, was where the good was located. Hence, Manicheism attributed a material origin to evil. Augustine, however, did not receive this teaching with pleasure, since, according to his understanding, the matter is the work of God's hands. Adopting the biblical perspective, then, the African thinker opposes the Manichean perspective, stating that all things created have their origin in God, who created them, as a result, all nature cannot exist except through him and it is a well, although he does not take part in it. This justifies, such as, why God is changeless and created things that are changeable.

Thus, the Bishop of Hippo reacts to the Mani's sect perspective, which deposits all the origin of evil in the matter and affirms that its condition of mutability is the reason for its residence and transmission. For Augustine, in contrast, as the matter is the product of God's creation, affirming it as the seat of evil is blasphemous by the reason of, according to the Scriptures, everything that God made was good.

Considering this, we cannot find evil within the mutability conditions of nature, as doing this means blasphemies God, since if evil dwells in matter, God would be responsible for it which the Augustinian thought does not admit. In this regard, evil must have another explanation that is disconnected from nature or from the continuous mutability of matter.

For Augustine, evil is good deprivation, and this is set as distancing from God. As such, there is no harm when God's creation complies its purpose with its creator. However, by deviating from the divine purpose, the creature corrupts its formerly good and perfect condition. Therefore, Augustine (n.d., para. 6) demonstrates this understanding of evil:

> When accordingly it is inquired, whence is evil, it must first be inquired, what is evil, which is nothing else than corruption, either of the measure, or the form, or the order, that belong to nature. Nature therefore which has been corrupted, is called evil, for assuredly when incorrupt it is good; but even when corrupt, so far as it is nature it is good, so far as it is corrupted it is evil.

Evil is the being corruption, this reveals itself in mode, species, or order, and when there are ruptures in this ontological field, evil is established. Thus, Augustine hopes to find the answer to the evil problem, as a result, he reacts against the Manichean proposal of asserting that evil is in the imperfection of the sensible world which makes the Creator responsible for the creature's defect. Starting from the analysis of nature, the *Confessions* author's intends to reach the human condition and he begins with the understanding that evil does not originate itself in matter or in nature, he tries to present a new place for the

origin of evil, namely: the problem of evil is now considered a problem of moral order.

> Therefore, a wanton will is the cause of all evils. If the will were in accordance with nature, surely it would maintain the nature and not be destructive of it; hence it would not be wanton. Accordingly, we may conclude that the root of all evils is not being in accordance with nature, which is a sufficient rejoinder to all those who want to lay the blame on natures. (Augustine, 2010, p. 107)

Consequently, evil in Augustine is not inherent in matter. The root of evil is in moral corruption and in will depravity which means that evil is the sin as a turning away from God. Considering that the human being is privileged among God's creatures, as he has the free will and became responsible for every degradation of his own nature which produces a second nature; in a corrupted state nonetheless, it is extended to external nature. According to Nunes Costa (2002), this understanding can be expanded: for understanding this issue, we must consider three premises. First, Augustine assumes that, in the universe created and governed by God, there is a gradation of values or perfections, both between God, which is the Supreme Good, and created beings, such as among beings created in relation to one another, who receive their degree of goodness by participating in that; second, among created beings, man occupies a privileged or superior place, as he is the only being that possesses reason or intelligence which makes him aware of the "divine order", and, on this account (third), he can freely choose (free will) between following it, thus contributing to the right order or disrespecting it, generating disorder represented by sin or evil. This means to say that evil appears as a guilty or sinful transgression of the divine order on the part of man.

From this perspective, evil is a moral condition that the being who freely chooses to turn away from God causes. Thereupon, it is in the will corruption, in the misuse of free will that the order break, which God established, producing the disorder caused by this perversion of the natural context. For this reason, the problem of evil in Augustine begins with the fall and original sin, which modifies the human condition, reproducing a second nature with the corruption first state. After the fall man loses control and sovereignty over himself:

> Before Adam's disobedience, he had the power not to sin. His condition then was posse non peccare: it was possible not to sin. After the disobedience and because of it, Adam's condition and that of all his posterity except Jesus Christ became non posse non peccare: not possible not to sin. (Olson, 1999, p. 172)

Therefore, sin corrupted human nature and produced in man the second nature, which is the corrupted version of the original condition. In reacting against Manichean thinking, about the origin of evil removed from matter and in the moral context, Augustine also opposes Pelagius who did not believe that sin affected man so much that he could not act freely for doing good. Receiving the work of the English monk, On Nature, the Bishop even with sympathy disagreed with the Pelagian anthropology.

Conforming to Augustine the human being has a corrupt nature and, as the fall consequences, there are conditions acquired with sin. In this perspective, if it is not for divine grace, which has the returning ability of the old splendor and perfection that man possessed before sin, man will stay in meager conditions without this precious resource and without any chance of getting rid of these conditions; he may fall of his own accord, but he cannot rise without the contest of the grace of God. Thus, Augustine considered the unhappiness in which humanity fell, due to original sin, as a just condemnation in which only through grace could it be freed, hence vehemently opposing Pelagius, who did not even accept original sin, sustaining that for men having a sinless life it only depended on them.

It is necessary to say, in view of the Augustinian work, that evil generated in human beings a new nature, which from the fall became much inferior to the original nature, which came directly from the hands of the Creator. The fall changed human nature and for Augustine, who claims to be following in the footsteps of biblical anthropology, this expanded the limitations in various spheres of human beings, which does not mean that man was not limited before original sin; however, these limits constituted the functions of its nature and delimited the reason for its creation. Coming to the fall, the limits went beyond functional issues and by causing evil to arise in the world by turning away from God, second nature took the place of the first state, creating a context where everything that was the product of humanity would be affected by this condition.

III. THE SECOND NATURE IN BLAISE PASCAL

In Augustine's view defending the scenario of the human condition, based on second nature, was essential to react against Mani's teachings view on the origin of evil; he also took the debate to the theological field of anthropology in his dialogues with Pelagius. Taking into account the problems and context differences, in the 17th century, we came across Blaise Pascal who was another

emblematic thinker and, as Augustine, positioned himself against the anthropology of his time, treating it both in the sphere of philosophy; he debated, therefore, with Cartesian philosophy in the theological field and in opposition to Molina's theology.

The 17th century is one of the periods in which Augustinian thought was resumed. Cartesian rationalism to a certain extent was influenced by Augustine's dimension of interiority directing his epistemological research to the subjectivity sphere. It culminated in the first truth of his reasons chain, namely, the cogito, a sine qua non for the universal science establishment that he intended; conforming Descartes (1989) explains in his book *Principles of philosophy*, this science would have, physics and moral as its trunk, mechanics and medicine as its branches, and metaphysics as its root. It is a fundamental point for modern western culture construction. In the fourth century, the Bishop of Hippo already indicates interiority as an instrument of searching for the truth, although with a very different purpose from the Cartesian one, since the Augustinian focus was proving the existence of God. On the other hand, in Descartes such proof is one more truth in the chain of reasons and, despite its importance, it does not even figure as an Archimedean point, as explained by Gilson (2006). For Augustine, the problem of knowledge and the problem of the existence of God are indistinguishable, in such a way that conceiving the truth and knowing the truth are part of the same issue. Indeed, Augustine turns to reason proving to himself that it is possible to prove the existence of God, for this purpose one of the obligatory passages is the certainty about his own existence. Augustine applies this point as follows:

> I am most certain that I am, and that I know and delight in this. In respect of these truths, I am not at all afraid of the arguments of the Academicians, who say, What if you are deceived? For if I am deceived, I am. For he who is not, cannot be deceived; and if I am deceived, by this same token I am. And since I am if I am deceived, how am I deceived in believing that I am? for it is certain that I am if I am deceived. Since, therefore, I, the person deceived, should be, even if I were deceived, certainly I am not deceived in this knowledge that I am. And, consequently, neither am I deceived in knowing that I know. For, as I know that I am, so I know this also, that I know. And when I love these two things, I add to them a certain third thing, namely, my love, which is of equal moment. For neither am I deceived in this, that I love, since in those things which I love I am not deceived; though even if these were false, it would still be true that I loved false things. [...] Further, as there is no one who does not wish to be happy, so there is no one who does not wish to be. For how can he be happy, if he is nothing? (Augustine, 2000, pp. 496 – 497).

For proving the certainty of his being, as a necessary journey to confirm the existence of God, which is the focus of his *démarche*, the interiority resource is used by the bishop; while Descartes uses cogito as the first truth and foundation of others, including the existence of God, all indispensable to his desired mathesis universalis.

In consideration of these differences and other differences that are beyond the aim of this article, such as the fact that in Augustine reason did not find the existence of God as in Descartes, it is possible to admit a certain influence of Augustine's thought not only on the Cartesian thought but still about other authors of great recognition in modernity. This clearly expresses the medieval thinker importance:

> Descartes was not alone in embracing the Augustinian path at the beginning of the modern era. In a sense those. two centuries, the sixteenth and seventeenth, can be seen as an immense flowering of Augustinian spirituality across all confessional differences, one which continued in its own way into the Enlightenment, as the case of Leibniz amply illustrates. (Taylor, 1989, p. 141).

According to Charles Taylor, as a result, every modern society comes from its origins with many important elements of Augustinian thought; and the philosopher from Hippo was one of the great providers of the modern context in the 16th and 17th century. If, on the one hand, Pascal reacts against the anthropocentric pretension of modern thought, on another hand, he uses the same source as these authors. Specifically, he also returns to Augustinian thought drawing inspiration from concepts that bases his oppositional thought, mainly, with regard to studies related to Grace that is a theme par excellence theological; he also turns to Augustine when it comes to questions of an anthropological nature, which is the moment that he investigates human nature composition, in its second state.

Luís Felipe Pondé, as demonstrating this approach, resorts to Phillippe Sellier's researches, who makes it clear that the Jansenist thinker, as Cartesian thought, also searched for bases in the African thinker in order to reach important points that led him to the most diverse questions. Pondé (2014), affirms that throughout Pascal's study, the world (matter and fallen soul) is presented as the dark face of reality. The anthropological and epistemological difficulties that torment man are nothing more than

manifestations of the human condition of living immersed in the darkness of the lustful world. Augustine, in his rich empirical-descriptive tendency, will found a vision of man that will unfold until the 20th century. Observing in the African author such man as insufficient, that is an anthropological conception, it is not difficult to understand, already in his youth, the radical Pascalian defense of Augustinism against humanist trends.

We clearly find, thus, in Pascal's thoughts similar elements of Augustine's anthropological presentation. In discussions with Pelagius, the Bishop of Hippo makes it clear that human nature entered a state of degradation due to original sin, producing a second nature and modifying, as a consequence, the human condition.

Pascal (1910, p. 137) states: “being lost, everything becomes its own nature; as the true good being lost, everything becomes its own true good”. The Jansenist at this point addresses the Augustinian thought and affirms that when man loses his first nature, then he must be analyzed according to the nature that remains to him; and doing this considering the transit from theological elements to the philosophical context. Accordingly, is Pascal legitimizing such principles for the context of rationality and why did he do that? Simply because current anthropology in accordance with humanism at that time failed to represent the human condition in agreement with the facts. Through rationalism, man can be aware of all true knowledge and therefore arrive at the solution of all problems, there is nothing in nature that seems resisting geometry. However:

> He was thus led to make that fundamental distinction between the "geometrical spirit" and the "acute or subtle spirit." The geometrical spirit excels in all these subjects that are capable of a perfect analysis - that may be divided into their first elements. It starts with certain axioms and from them it draws inferences the truth of which can be demonstrated by universal logical rules. The advantage of this spirit consists in the clarity of its principles and in the necessity of its deductions. But not all objects are capable of such treatment. There are things which because of their subtlety and their infinite variety defy every attempt at logical analysis. And if there is anything in the world that we have to treat in this second way, it is the mind of man. What characterizes man is the richness and subtlety, the variety and versatility of his nature. Hence mathematics can never become the instrument of a true doctrine of man, of a philosophical anthropology. (Cassirer, 1944, p. 32).

The active reason is not enough for meeting all needs, as it configures itself as a faculty of second nature and everything that it measures by its criteria finds the limits of its application. Hence, anthropology based on rationalism, namely, on the scientific spirit, does not find legitimacy in Pascal for the study of the human condition.

The rationalists' analysis would content themselves with empirical data which human nature offers; this is transmitted by characteristics, as the finitude and as the contradiction, that they did not have any interest. Instead, they based themselves on metaphysical principles for analyzing metaphysical questions and somehow introduce such questions into the empirical world. However, Pascal uses such data for applying the concept of second nature, since he thinks about the human condition in an unworkable and perishable context. It is due to this space of finitude and of contradiction that Pascal chooses the second nature concept as the principle of the human condition which is a condition assumed after the fall.

It is from this perspective that Pascal considers the human condition. Customs, morals, politics, even knowledge productions are within the context of second nature. Everything related to the first nature condition was lost with the fall. Thus, the temporal, contradictory, and finite character of both society and human productions, as well as the human condition itself, provided a foundation for Pascal using categories of theological order, due to its applicability to the historical-spatial condition of man, therefore, as Pascal wrote (1910, p. 41): “There is nothing he may not make natural; there is nothing natural he may not lose”.

Since nothing social is based on something really natural, Pascal considers that all these applications are within a randomness infinity, according to the imagination of those who run society; and then the Jansenist reflects:

> You have no right to it of yourself and by your own nature any more than he: and not only do you find yourself the son of a duke, but also do you find yourself in the world at all, only through an infinity of chances. Your birth depends on a marriage, or rather on the marriages of all those from whom you descend. But upon what do these marriages depend? A visit made by chance, an idle word, a thousand unforeseen occasions. (Pascal, 1910, p. 378)

Pascal ponders that such human condition is similar to a man who was thrown by a storm on an unknown island, where its natives were worried about finding their lost king and this man had similarities to the island's monarch. After hesitating, he accepts such luck receiving all the privileges a king should receive. In his reflections yet, he could not

forget his true state in which he was actually a castaway and was not the king of that people; even speaking as a king and acting as such but for maintaining his privileges he concealed the truth of the people while treating everyone according to his appearance.

Every power, privilege, or social condition is not based on nature, but on laws based on a chain of contingencies and on the fantasies that make the law. Considering this, Pascal demonstrates that everything established in the second human nature is also in this context of infinite chance. Therefore:

> The two principles of truth, reason and senses, are not only both not genuine, but are engaged in mutual deception. The senses deceive reason through false appearances, and, just as they trick the soul, they are tricked by it in their turn: it takes its revenge. The senses are disturbed by passions, which produce false impressions. They both compete in lies and deception. (Pascal, 1995, p. 46)

Consequently, Pascal invites man for reflecting on his own condition, as knowing about the truth of himself is already considered as a demonstration of greatness, since "man's greatness comes from knowing he is wretched: a tree does not know it is wretched. Thus, it is wretched to know that one is wretched, but there is greatness in knowing one is wretched." (Pascal, 1995, p. 65). Such greatness, as demonstrated, allows us to notice misery as the foundation of the human constitution.

The Jansenist then establishes, as demonstrating the human nature condition, his apologetic work on the Christian religion, showing that, unlike other religions and as the current humanist thought from that time, the Christian religion was the only one demonstrating its nature reality, and, therefore, it has truths accessible only by faith which must be considered, in other words, the full knowledge of oneself and the knowledge of God. About this Pascal said:

> It is truly glorious for religion to have such unreasonable men as enemies: their opposition represents so small a danger that it serves on the contrary to establish the truths of religion. For the Christian faith consists almost wholly in establishing these two things: The corruption of nature and the redemption of Christ. Now, I maintain that, if they do not serve to prove the truth of the redemption by the sanctity of their conduct, they do at least admirably serve to prove the corruption of nature by such unnatural sentiments. (1995, p. 173).

Pascal also states that this other source of knowledge, that is present in man, is the heart which is the place that, if well directed, is led by true faith and it has the ability to feel God and access knowledge that is inaccessible to reason, since "The heart has its reasons, which reason does not know" (Pascal, 1910, p. 98). Then, there are the following reasons of heart:

> It is the heart which perceives God and not the reason. That is what faith is: God perceived by the heart, not by the reason. […] Faith is a gift of God. Do not imagine that we describe it as a gift of reason. Other religions do not say that about their faith. They offered nothing but reason as a way to faith, and yet it does not lead there. (Pascal, 1995, pp. 169 – 245)

Therefore, in Pascal faith is important for man knowing beyond what he could know by reason alone. As Augustine combines faith and reason for man can reach the interior of himself, the knowledge of himself, and the truth and God. Pascal makes use of a similar resource for combating the humanist pretension and defending the foundations of the Christian religion, as well as its usefulness to man.

IV. CONCLUSION

Augustine and Pascal, each within their time context, both through faith and reason for presenting their anthropology based on the Christian perspective. Each of these authors provided a vast amount of culture and knowledge in their respective contexts. The Bishop of Hippo talks about the items of faith through reason, while dealing with rational issues within the context of faith. He does this in a conciliatory manner, avoiding falling both into rationalism and fideism. Pascal is also an expert in the issues that most define the 17th century and rejects falling into the tricks of fideism, skepticism, as well as rationalism in its extremes; following in the footsteps of Augustine, he reaffirms the place of faith along the reason for presenting anthropology that was in accordance with the facts of reality and that did not tend only to reason pretensions or to the testimonies of the senses.

Both Augustinian and Pascalian anthropology start from the narrative of the fall for supporting the human condition context. The human actuality nature stems from the change suffered by original sin, a problem of a moral order that underlies the cause of evil and the loss of the first nature, as well as adherence to fallen nature for both authors. According to Sellier (1995, p. 232) Pascal and Augustine, therefore, when dealing with original sin appeal to the Evangelical Tradition, in other words, to Scripture, to the way it was understood in the different

stages of the Church's life, and to the liturgy. But this Tradition explains a state of affairs, it does not create it. Then, it is clear that the Augustinian theologian could turn from an empirical consideration of the present state of man to his theological explanation.

It is in this way that Pascal maintains a constant flow between theological and philosophical discourse, reconciling faith and reason, valuing both the items of faith and the prepositions of reason. However, since the empirical data correspond much more with the narrative of the Christian faith than the pretensions of humanist reason in the 16th and 17th centuries, the Jansenist then, following in the footsteps of Augustine:

> The opposition greatness/misery is very traditional. No doubt, in Pascal it achieves its extreme form, but, at the same time, he brings it to its final moment. In any case, even if his thought appears to have considerable force, Pascal is not an original thinker in this case; on the contrary, Pascal does not pretend to do anything but reactualize Saint Augustine's *De vera religione*, which is his model. (Carraud, 2005, p. 543)

Nonetheless, Pascal's thought, even starting from the Augustinian position, could not be closed within the limits of this thought. Rethinking human nature made it possible for the amplified Pascalian understanding. Sellier (1995) considers that Pascal also surpassed the Bishop of Hippo in painting the psychological inconstancy of the human being. Not only is man just a toy among the elements, but he himself is fleeing and changing. These are variations according to time, place, temperament as others.

In the second nature, both Augustine and Pascal present a man who could be identified within a rational discourse without conflicting with the revelations of faith, especially, it is only in this way that making anthropology becomes possible for these authors. Man's actuality is the result of abandoning his first condition and from a perfect being, created by God. Man passes to a state of finitude, subject to the determinations of time and history which in themselves are the manifestations of this second state.

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Health and nutrition of Health professionals in Hospital during the COVID-19 Pandemic: An Integrative Review

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***Keyword*—COVID-19, mental health, nutrition, healthprofessionals, pandemic.**

***Abstract*—*The SARS-CoV-2 virus gave rise to the COVID-19 pandemic, from the outbreak in the city of Wuhan, China, in 2019, giving rise to several research questions, and one of them is concern about the health of the health professionals during the pandemic period. Therefore, this integrative review sought to present the nutritional and health aspects related to these professionals during the pandemic. The review was carried out in six stages: 1. elaboration of the research question, 2. definition of the sources for the selection of primary studies and the inclusion and exclusion criteria, 3. definition and extraction of data, 4. evaluation of the included studies, 5 .critical analysis of the results, 6. presentation of the synthesis of the evidence found. With regard to health, which encompassed the quality of sleep, the practice of physical activities, the mental health and nutrition of health professionals, the studies analyzed suggest actions to promote and protect the mental health of professionals and point out the need for to better address this area, as well as to increase the incentive for a balanced and healthy diet, both in the hospital environment and at home, highlighting the importance of these areas for the maintenance of the well-being and health of the professional, and consequently for the delivering good results in the work environment.*

I. INTRODUCTION

The SARS-CoV-2 virus gave rise to the COVID-19 pandemic, from the outbreak in the city of Wuhan, China, in 2019. The international concern was evidenced by the WHO (World Health Organization) in January of 2020 the first contagion and outbreak of the infectious disease outside China was reported in Thailand, at the end of the month WHO described COVID-19 as a public health emergency of international concern [1, 2].Strategic plans for fighting the COVID-19 pandemic had not been made before the outbreak of the SARS-CoV-2 virus outbreak, but the WHO, with the help of various scientific researches, developed strategies and guidelines for fighting COVID- 19. Social isolation constitutes the first ways to prevent exacerbated contagion of the virus, in addition to the use of masks, hand washing and the application of 70% alcohol, to health professionals include other PPE equipment such as: gloves, N95 masks, disposable clothing, glasses and protectors [3, 1, 2]. Health professionals are of great importance to face the new pandemic, which makes them more prone to contagion and illness, due to high exposure to viral load during the care of infected patients. The pandemic caused an increase in reports of problems such as sleep, anxiety and sadness in adults; however, these situations are inherent to health professionals, where the exhaustion and high social pressure aimed at this public, allows the involvement of

mental health with increased anxiety, stress and even depression [4, 5, 6].

The population's dietary changes are present throughout the history of Brazilian society, especially with the advent of globalization, with eating habits characterized by increased consumption of processed and ultra-processed foods together with increased consumption of products with high levels of simple sugars, fats saturated and reduced consumption of fresh foods. Regular and high consumption of unhealthy foods, in addition to physical inactivity are considered relevant factors for the increased risk of developing cardiovascular diseases among the population [7, 8].

Thus, the studies, in which they seek to know about the diet of health professionals, is of great importance to analyze eating habits and risk factors, and also to know whether the adopted food consumption is adequate, thus contributing to an improvement in quality of life of these individuals. In this integrative review, we aim to describe aspects related to the health and nutrition of health professionals in hospital units during the COVID-19 pandemic. Specifically identify the eating habits, as well as the health habits of these professionals. In addition to describing risk and protection practices related to them during the pandemic.

II. METHODOLOGY

2.2 Type of study

This is an integrative literature review that was developed in six stages: 1. elaboration of the research question, 2. definition of the sources for the selection of primary studies and the inclusion and exclusion criteria, 3. definition and extraction of data, 4 .evaluation of the included studies, 5. critical analysis of the results, 6.Synthesis presentation of the evidence found [9].

To prepare the research question, the Population - Interest - Context (PICo) strategy was used, in which P - health professionals, I - health and nutrition, and Covid-19 Co-Pandemic were considered. Thus, the guiding question was: How was the health and diet of health professionals affected during the COVID-19 pandemic?

2.2.1 Scenario

The search for primary studies was performed in the Virtual Library en Salud (BVS)/BIREME, Pubmed and Scielo. Using the following descriptors in English: health professionals, pandemic and eating behavior.

Access to the database took place in December 2021 through the researchers' personal remote access.

2.2.2 Inclusion Criteria

As a method of selecting the articles to compose the review sample, the following inclusion criteria were adopted: primary studies that present topics related to the health and nutrition of health professionals during the pandemic period, available in Portuguese and English published during the period from March 2019 to November 2021. As exclusion criteria, the following were adopted: dissertations, thesis and case report.

2. 2.3 Data collection

To carry out the search in the databases, controlled descriptors (hierarchically structured terms used in indexing the bases) from the Medical Subject Headings (MeSH), Descriptors in Health Sciences (DeCS) were used. The descriptors were cited in the search of the Bireme, PubMed and Scielo databases with the AND connector and no synonyms were used during a one-week period. The search strategy was conducted in order to contemplate the peculiarities of the database and time restriction filters were added (last 5 years).

2.2.4 Data analysis

The search for studies, screening and data extraction were performed by two researchers, who standardized the search strategy in the database and performed it independently, with subsequent comparison of the results found.

The analysis and integration of results was based on the data reduction method, which consisted of critical reading. And for theoretical support for the critical analysis of the results, the scientific literature on the subject was used, and these studies were not included in the review. The presentation of results and discussion took place in a descriptive way, aiming to promote the incorporation of evidence and identification of gaps in knowledge.

Table. 1: Database search strategy

Data base	Search strategy
BIREME	health professionals AND pandemic AND eating behavior
Pubmed/Medline	health professionals AND pandemic AND eating behavior
Scielo	health professionals AND pandemic AND eating behavior

The review variables were categorized in a spreadsheet using the Microsoft Excel 2010 program, containing the following information available in primary studies: year, country, type of study, objectives, method and conclusion.

2.2.5 Ethical aspects

The protocol for this study will not be submitted to the Research Ethics Committee, as public access studies available in the scientific literature will be used.

III. RESULTS

During the manual search in the database, 63 studies were identified, after comparing the databases for the removal of repeated articles, 23 studies were selected, 1 of which was duplicated. Remaining 22 articles for reading the abstracts: 20 in Pubmed/Medline and 2 in LILACS. After applying the selection criteria, 10 studies were included for analysis. The main reason for exclusion from the studies was the avoidance of the theme.

In the end, 9 articles were included, 100% of them from Pubmed/Medline. Regarding language, all articles were published in English. With regard to the countries where the surveys were conducted, 33% of the studies were carried out in Spain, 22% in Vietnam, 11% in Brazil, 11% in the USA, 11% in Germany and 11% in Poland.

Regarding the type of study, 33% were observational, descriptive and cross-sectional studies; 11% descriptive, observational and longitudinal study; 11% cross-sectional and analytical study; 33% cross-sectional and observational study and 11% cross-sectional study.

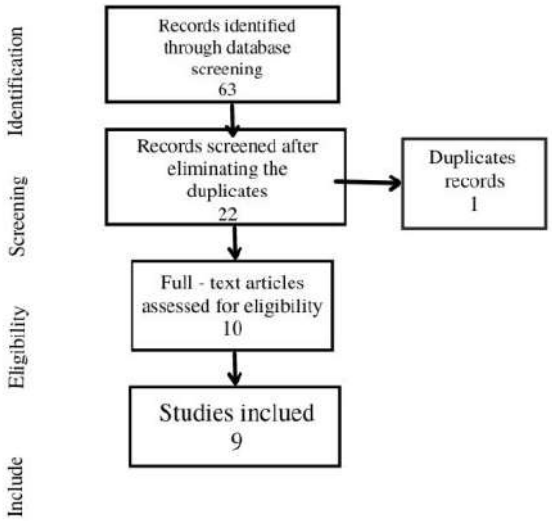

Fig.1: Flowchart of the integrative review article selection process.

Regarding data collection through electronic questionnaires or applications, it was possible to notice that 44% of the studies used them in their methodology.

The Table. 2 presents the methodology, objectives, results and conclusion of the primary studies.

Table.2: Summary of articles selected for integrative review.

TITLE	AIM	METHODOLOGY	RESULTS	CONCLUSION
Health Literacy, eHealth Literacy, Adherence to Infection Prevention and Control Procedures, Lifestyle Changes, and Suspected COVID-19 Symptoms Among Health Care Workers During Lockdown: Online Survey [10].	The aim of this study is to assess the psychometric properties of eHEALS and examine the associations of HL and eHEALS scores with adherence to infection prevention and control (IPC) procedures, lifestyle changes, and suspected symptoms of COVID-19 among healthcare professionals during blocking.	Cross-sectional study, carried out in Vietnam with 5,209 health professionals from hospitals and health centers, using an online questionnaire from April 6 to 19, 2020, in the period that encompasses the national blockade measure. The survey verified suspicion of COVID-19, sociodemographic data of the participants, literacy and health literacy (HL, eHEALS), changes in eating behavior and physical activity.	The proportion of female health professionals corresponded to 67.15% and 32.9% of males, men achieved higher HL and eHEALS scores and obtained greater adherence to infection prevention and control measures (IPC) and fewer symptoms associated with COVID- 19. The highest HL and eHEALS scores are related to a higher probability of unaltered and healthy eating and unaltered and higher physical activity, only 5.2% of health professionals had comorbidities and 3.2% started to eat less healthy.	eHEALS is a reliable and important tool to assess eHealth literacy. The highest HL and eHEALS scores were achieved by men, where the highest scores are associated with greater adherence to the IPC, greater likelihood of healthy eating, with a lower percentage of physical inactivity and lower suspicion of COVID-19. The negative pandemic outcomes and the containment of the Covid-19

				pandemic can be positively affected with the improvement in HL and eHEALS scores.
Impacts and interactions of COVID-19 response involvement, health-related behaviours, health literacy on anxiety, depression and health-related quality of life among healthcare workers: a cross-sectional study [11].	To examine the impacts and interactions of COVID-19 response involvement, health-related behaviors, and health literacy (HL) on anxiety, depression, and health-related quality of life (HRQoL) among health care professionals (HCWs).	The study is a cross-sectional study, encompassing 7,124 health professionals from hospitals and health centers in Vietnam, aged between 21 and 60 years, from April 6 to April 19, 2020 with an online questionnaire. Data analyzed were social demography and indicators, health-related behaviors, health literacy, mental health and health-related quality of life.	Of the health professionals involved in the survey, 66.2% were women, 11.1% of the health personnel were Overweight (BMI ≥25.0) , only 4.3% indicated eating less healthy food in the pandemic With a less healthy diet (4.3%) and 38.4% reported never practicing physical activity/stopping or exercising less. Health professionals who were working directly on the COVID-19 response had higher probability of anxiety and depression, however individuals with unaltered eating habits, healthier and more physically active had lower probability of anxiety and depression. Distance in involvement with COVID-19 improved HRQOL resulting in less likelihood of anxiety and depression.	Health professionals who were working in sites destined for the COVID-19 pandemic were more likely to have compromised mental health and lower HRQOL, with worsening anxiety and depression related to drinking alcoholic beverages and smoking. Healthy food consumption, as well as the practice of physical exercise is linked to the probability of increased HRQOL and lower anxiety and depression, health literacy is a protective factor as well as the practice of physical exercise, so it is important to study to analyze the lifestyle of health professionals.
Clinical Factors, Preventive Behaviours and Temporal Outcomes Associated with COVID-19 Infection in Health Professionals at a Spanish Hospital [12].	The objectives of this study were to determine the prevalence of symptoms, main concerns as patients, preventive behaviors of health professionals and the different temporal outcomes associated with the negativity of CRP results.	It was analyzed 76 health professionals with symptoms and positive test for COVID-19 in the period between March 11 and April 13, 2020 in Spain. Follow-up was conducted using questionnaires, clinical records and telephone interviews to obtain data on possible hospitalizations, first PCR positive and PCR negative.	The result showed that there was greater concern about contagion in the work and family environment (44.7%), the average age of participants being 45.8. 59.2% had gastrointestinal symptoms, 61.8% cough, fever and 84.2% of them had fatigue. Only 14.5% of health professionals needed hospitalization, in relation to comorbidities 10.5% were hypertensive, 10.5% had asthma, 6.6% Chronic lung disease and 6.6% were diabetic. There was a high prevalence (82.9%) of hand	The work environment represented a worrying factor for health professionals as a contagion of COVID-19 as well as the family environment, the use of masks before the pandemic was considerably low in men. Furthermore, there was a predominance of gastrointestinal symptoms, especially diarrhea, followed by

			hygiene as preventive behavior before the pandemic and low use of masks by male professionals (4.55%).	episodes of fever, cough and fatigue. The time of CRP negativization may be longer in female health professionals aged 55 years or over.
Analysis of eating habits among the main health care agents in health promotion (physicians and nurses) of emergency services in times of COVID-19 [13].	To determine the nutritional habits of health professionals in hospital emergency services during the COVID-19 pandemic.	The study was carried out with health professionals from a hospital located in Spain, of a descriptive and longitudinal type, a mobile app (e-12HR) was used for 28 days to assess eating habits and adherence to the Mediterranean diet.	The number of study professionals was 44, with a mean age of 47.7 years, with a higher prevalence of females (52.3%), 45.5% were overweight and 43.2% were obese, with a greater predominance of moderate physical activities . Adherence to the Mediterranean diet was 5.98 points, there was a higher consumption of sweets and snacks in individuals with BMI ≥ 25.0 kg / m 2, there was compliance with the recommendations in a percentage of less than 30% in relation to the consumption of fruits and vegetables , milk and dairy products. The nursing staff had greater adherence to the Mediterranean diet pattern compared to physicians.	The study demonstrated a lower consumption of fruits, vegetables, milk and dairy products, and other groups such as pasta, rice, bread, cereals, white meat, nuts, eggs and red and processed meat, and, therefore, showed low adherence to food based in the Mediterranean food pattern, especially doctors. Thus, it is important to promote health with the appreciation and encouragement of healthy eating habits by public health authorities.
Nutrition Strategies for Reducing Risk of Burnout Among Physicians and Health Care Professionals [14].	Describe the evidence found in the literature on dietary and mental health interventions used to improve the well-being of health professionals during and after the COVID-19 pandemic.	The methodology of this article was not described by the author	The cardiovascular and health benefits of the Mediterranean diet have been well described and have recently been shown to protect against depression. The traditional Mediterranean diet includes a high intake of vegetables, fruits, vegetables, nuts, seeds, whole grains and olive oil, with a moderate intake of fish and a low intake of highly processed foods and red meat. Evidence was provided on the Mediterranean dietary pattern and the supportive role that specific nutrients	In the article, the potential of nutrition to mitigate the risk of burnout among physicians and health professionals was presented. Burnout is associated with chronic stress and unhealthy eating habits, which include high consumption of processed and fast foods, emotional eating and excessive food consumption. Meanwhile, it is observed that physicians have

			play in optimal brain function and mental health. These findings can be applied to physicians and healthcare professionals to reduce the risk of burnout, providing physical and mental health benefits. Efforts to support adherence to this dietary pattern can benefit this population and, at the very least, efforts to reduce intake of highly processed foods and red meats by increasing intake of fruits, vegetables, whole grains and other dietary components Mediterranean should be considered. Effective strategies to promote long-term and sustainable behavior change among this population are needed to fully realize the benefits of these dietary recommendations. Mindfulness-Based Food Awareness Training is an intervention designed to promote mindful eating practices, helping individuals to cultivate an awareness of internal and external triggers for eating, preventing automatic eating, and eating in response to natural hunger signals. Individuals with burnout, especially women, may be at high risk for emotional eating, where mindful eating interventions can be particularly beneficial.	limited adherence to dietary recommendations and inadequate nutritional education in their medical training. The mechanisms by which nutrients are involved at a cellular level, in brain health, inflammation and the functioning of the central nervous system, support the growing body of knowledge about the mental health benefits of a Mediterranean diet pattern. Effective strategies to improve nutrition behaviors include nutrition education and counseling, and conscious eating interventions, whereas policy and institutional level supports include workplace wellness, healthy eating policy, and incorporation of nutrition skills into the training curriculum doctor. It is concluded that COVID-19 exacerbated the risk of burnout in an already high-risk population of physicians, and multilevel strategies to improve nutritional status may help to reduce the risk of burnout..
Impact of COVID-19 on eating habits, physical activity and sleep in	Investigate changes in the daily life and sleep habits of health professionals in Brazil.	A Google Forms questionnaire was made available to Brazilian healthcare professionals on the WhatsApp mobile	The sample (n = 710) was composed mostly of women (80.8%), aged between 30 and 40 years (46.6%), predominantly doctors	In this study, Brazilian health professionals showed aspects of quality of life that were more

Brazilian healthcare professionals [15].		application and through the website of Empresa Brasileira de Serviços Hospitalares. The periodwasfrom May to July 2020.	(41.8%) and mostly residents of the state from Paraíba (66.9%), Brazil. Approximately two thirds of the total sample had some sleep-related complaint, 25.8% due to difficulty falling asleep, 29.6% due to difficulty staying asleep and 32.5% due to morning awakening. Of the population studied, 28.7% (n = 204) reported using medication for insomnia, and 60.3% (n = 123) of them self-medicated. Some participants reported a change in diet (n = 557; 78.5%), mainly related to increased carbohydrate intake (n = 174; 24.5%), and 27% (n = 192) of subjects reported an increase in carbohydrate intake. consumption of alcoholic beverages. Of the total, 561 (81.8%) reported a change in the practice of physical activity.	affected during the COVID-19 pandemic than the prevalence observed in surveys of international studies for the general population.
Neglected workforce: pharmacists and their health-related quality of life [16].	The main objective of the study was to evaluate HQoL of Polish pharmacists using the SF-36 health questionnaire with regard to anthropometric and lifestyle-related variables.	The total screened sample consisted of 1412 respondents, but 765 pharmacists (mean age 40 years, 86.3% women) ultimately participated in the study. HQoL was assessed with the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36).	The lowest median scores were observed for the domains of general health (GH, 50.0) and vitality (V, 60.0). No gender differences were found regarding physical and mental summary scores. A significant difference in the HQoL was found between the age groups assessed in several domains, mainly in the physical function (PF) and GH scores, and mainly in the group of respondents aged 51 to 60 years. Correlations were found between PF (r = -0.29), GH (r = -0.25) and age, as well as PF (r = -0.27), GH (r = -0.21) and BMI. Self-rated dietary habits were	The analysis indicates that pharmacists tend to have a similar physical and mental load according to the SF-36, with age, BMI and eating habits being the predominant factors influencing their HQoL. The study presents unique values for future comparative analyzes related, for example, to the influence of the ongoing pandemic on the HQoL of healthcare providers.

			correlated with PF (r = 0.22), mental health (r = 0.25), GH (r = 0.27), and V (r = 0.30) scores.	
The Health Behaviour of German Outpatient Caregivers in Relation to the COVID-19 Pandemic: A Mixed-Methods Study [17].	The objectives of the study were to examine health behavior and explore the perceived change in pandemic-related health behavior among outpatient caregivers during the COVID-19 pandemic.	In a mixed-methods study, 15 problem-centred interviews and a web-based cross-sectional survey (N=171) were carried out with outpatient caregivers working in northern Germany. Respondents reported partially worse eating behavior, higher coffee consumption, less physical activity, skipping breaks more often, and less duration and quality of sleep during the pandemic.	Some quantitative results indicate the same trends. Most participants were smokers and reported a higher perception of stress due to the pandemic. Preventive behavior, such as using PPE or hand hygiene, increased among respondents compared to the pre-pandemic period.	Results indicated that the COVID-19 pandemic may negatively affect the health behavior of outpatient caregivers, eg eating/drinking and physical activity.
Effect of COVID-19 Lockdown on Dietary Habits and Lifestyle of Food Science Students and Professionals from Spain [18].	This study aimed to evaluate changes in eating habits and lifestyle during COVID-19 blockade in a specific population with academic and professional knowledge in food science in Spain.	Foi aplicado um questionário online, baseado em 41 itens, incluindo dados sociodemográficos, hábitos alimentares, comportamentos relacionados à alimentação e estilo de vida, foi distribuído por meio de mala direta acadêmica, institucional e mídia social.	The results showed increased intake of fruits and vegetables, vegetables, eggs, fish and yogurt, along with a decrease in alcohol consumption between before and during the blocking period. Even so, there was also an increase in the consumption of some fruitful foods and an increase in self-reported weight, although in smaller percentages than in other populations. Worse sleep quality and increased working hours and sitting time were also reported.	Overall, trends towards healthier eating habits were observed in the study sample during the COVID-19 confinement period.

From the selected studies, 88.8% of them discussed about food consumption in conjunction with other factors associated with health, 55.5% addressed physical activity at some level, 44.4% mental health, 33.3% about sleep .

Regarding alcohol consumption, 44.4% of the studies analyzed alterations and/or associations with the consumption of alcoholic beverages in conjunction with other factors, and 22.2% of the studies analyzed alterations in the smoking habit and the consumption of alcoholic beverages.

IV. DISCUSSION

4.1 Mentalhealthofhealthprofessionals

As shown in this work, with few published studies, the theme is conducted, according to BARROS et al., [4] there is a deficit of information and scientific knowledge on the prevalence of food consumption and changes in lifestyle, as well as on stress, anxiety, sleep disorders and depression that hover over health professionals. Since these professionals have the role of promoting and restoring the health of the population, that is, neglecting their well-being, it can harm the adoption of public policies conducted efficiently and appropriately, in the search for

the best way to coordinate the fight against future pandemics and the search to reduce the negative impacts they may trigger.

As expected, one of the main health problems affecting professionals fighting the 2019 pandemic was described in most studies: contamination by the COVID-19 viruses. It considered the base of health and well-being problems of professionals, as it triggers the fear of contamination from family and friends, leading, beyond physical illnesses, to the development of illnesses and psychological disorders. In their integrative review on the topic, TEIXEIRA et al., [6] reported on aspects related to contamination by the virus, such as fear of being infected, proximity to the suffering of patients or their death, as well as the anguish of family members associated with the lack of medical supplies, uncertain information about various resources, loneliness and concerns about loved ones can lead the professional, in some cases, to withdraw from the medical service. In view of these findings, the creation of psychological support networks for this population in hospitals is suggested, with the creation of specific protocols for each risk situation, with constant training of the support team in order to keep them always prepared for the psychological care of health professionals.

In relation to the analyzed studies, a slight heterogeneity in relation to the term health professionals is perceived. It covered the term for non-medical professionals such as nurses and pharmacists. As a finding discussed by TEIXEIRA et al., [6] in their review study, considering it as a generic term and without specification of the heterogeneity that covers it.

4.2 Digital screening and counseling methodologies

The use of online questionnaires and applications (Google Forms, e-12HR and Whatsapp) to obtain data, according to the findings of this review, demonstrate some of the various possibilities for conducting non-invasive and more comprehensive research. In addition to the use of electronic assessment tools, such as eHEALS and HQoL to verify the health status of professionals. According to studies by SHEN et al., [19] research in digital disease surveillance, also known as *infovigilance*, has shown significant potential in the useful use of internet data to track the real-time development of public health and behavior. Thus demonstrating the need for research investments in this method, in order to improve it and improve the accuracy of the data obtained. In addition to it could be potential mediating tools, both for psychological support and for medical consultations.

4.3 Eating habits and physical activity

Most studies showed that eating habits were changed during the pandemic, collaborating with the findings of Costa et al., [20] with the consumption of fruits and vegetables being inadequate in part of the studies, and despite an increase in consumption of this food group, it remained lower than recommended. Silva, Domingues and Bierhals [21] evaluated the nutrition of nursing professionals during the pandemic, and the consumption of sugary foods, soft drinks and sweets was high, in addition to the consumption of more caloric and mostly ultra-processed and processed foods throughout the week of nurses. And according to Depolli et al., [22] in addition to healthy eating habits, physical activity is directly related to improved mental health, with a decrease in the probability of developing GAD and depression, and should always be encouraged, especially for health professionals. health, essential parts in the fight against the pandemic and health promoters.

In this context, physical activity was also a variable analyzed in the studies, and it became clear that the decrease in physical exercise and sedentary lifestyle were factors triggered by the pandemic. As shown by Mayer et al., [23] in their studies during compliance with US proposed physical activity guidelines in the initial period of SARS-Cov-2 blockade, fewer physical exercise practices were reported in the pandemic period compared to to the period prior to COVID-19. And according to Petterson et al., [24] physical inactivity represents a risk factor for the development of Cardiovascular Diseases, Cancer and Diabetes Mellitus, in addition to chronic diseases, with lifestyle being linked to an increased risk for clinical complications such as hospitalizations [24].

Regarding the subject, the importance of a healthy and balanced diet to prevent the development of diseases, as well as to restore health if the individual is affected by them, is unquestionable. And allied to healthy eating is the practice of exercise, which together work to maintain health, not only for professionals working in hospitals, but for the population in general. However, as shown by the studies, there is a lack of information about health and nutrition specifically from health professionals, therefore, it is suggested that research be developed that address both themes. Beyond incentives about healthy eating for these professionals in the workplace through lectures, conversation circles and training courses.

4.4 alcohol consumption

Alcohol consumption increased in studies involving health professionals, Skrzynski and Creswell [25] argue that this situation is observed as a means to deal with losses, frustrations, stress and anxiety, WARDELL et al., [26]

emphasize that the consumption of alcohol can be related to several external and internal aspects of the individual linked to the pandemic and its negative repercussions, especially deaths and loss of friends and family.

In this context, psychological support is even more necessary to help health professionals in times such as the COVID-19 pandemic. The use of conversation circles and psychological care, with the aim of welcoming them and preventing fears and anxieties about alcohol consumption, can be measures adopted by hospitals continuously, and not only during pandemic periods. as they are professionals experiencing daily pressure and stress in the work environment.

V. CONCLUSION

This review showed a low but growing amount of studies in relation to the health and food consumption of professionals working on the front lines during the pandemic. This theme is current and of international interest.

With regard to health, which encompassed the practice of physical activities, mental health and nutrition of health professionals, the studies analyzed suggest actions to promote and protect the physical and mental health of professionals and point to the need to better address this area, as well as increasing the incentive for a balanced and healthy diet, both in the hospital environment and at home, highlighting the importance of these areas for the maintenance of the well-being and health of the professional, and consequently for the delivery of good results in the work environment.

Regarding the consumption of fresh food, and the adoption of healthy eating, despite being present in the articles, as an object of research, and presenting positive results in some studies in this review, in general, they showed low adherence among health professionals and individuals. holders of knowledge in the science of nutrition, thus demonstrating the vulnerability of this audience.

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Estimate of Vigor Classes of Brachiaria Ruziziensis using Sensors Boarded on UAV Platform

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Keywords *— **Forage, UAV, Remote Sensing, Vegetation index.***

Abstract *— Traditional procedures for biomass estimation usually use destructive methods with great demands on time, resources, and labor. The development of models for automated estimation of pasture biomass, particularly from images captured by Unmanned Aerial Vehicle (UAV), in addition to high spatiotemporal resolution combined with flexibility in image acquisition, provides agility, the economy of resources, and labor. The objective of this work was to establish a technical feasibility study for the use of multispectral sensors onboard an Unmanned Aerial Vehicle (UAV) to estimate the vigor classes of Brachiaria ruziziensis pastures. For this purpose, imaging cameras in the visible (RGB), near-infrared and red edge ranges were used for continuous monitoring of 20 pasture paddocks with an area of 1,350 m^2 each, totaling 27,000 m^2 of the experimental area. The indices performed well and were sensitive in class discrimination at intervals that range from soil exposure and stresses caused by pest and disease infestation (low vigor) to conditions in which the vegetation is in good development, in class intervals with high levels of vegetation and, consequently, pointing to high values of biomass.*

I. INTRODUCTION

The non-destructive and appropriate monitoring of the biophysical characteristics of the plants is paramount in evaluating their physiological and phenological conditions and, consequently, in better understanding their functioning over time [1]. Some of the most relevant biophysical characteristics to be monitored characterize the efficiency with which light, water, and nutrients are captured and used for biomass production [2].

Remote sensing techniques have been used for decades to monitor vegetation. However, in the last years, the interest in the use of automated techniques and procedures with a good spatial and temporal resolution to monitor plant growth and development [3, 4, 5] has increased.

The remote sensing satellite images usually lack high spatial resolution, therefore the details of plants or small plots of field plantations can be observed. In addition, it can also be poor in terms of temporal resolution, that is, the frequency of revisiting combined with the possible occurrence of clouds limits the use of satellites for detailed agricultural applications when there is a need to monitor the crop at daily scales or in critical periods to optimize decision-making. In this context, unmanned aerial vehicles (UAVs) can be an interesting alternative as they offer high spatial and temporal resolution and proper imaging coverage.

Technological advances in UAVs platforms and cost reductions have been the major factors in the increase in the use of this platform for civil purposes. The UAV technology, in addition to allowing pre-programmed and automated flights with the aid of a global positioning system (GPS), can contribute to filling the knowledge gap between the leaf and the canopy by considerably

improving the spatial and temporal resolution of the commonly used air transport systems of remote sensing [6]. This technology has stood out in the so-called smart farms, showing efficiency in collecting data to extract knowledge that enables more accurate assessments of crop conditions [7].

Imaging sensors onboard UAVs can collect data both in the visible range (RGB sensors) and in the near-infrared and thermal ranges. Multispectral cameras, for example, enable the extraction of information in different bands of the electromagnetic spectrum. Sensors onboard of UAV platforms enable the generation of spectral indices and other products such as digital terrain model (DTM), 3D modeling, image orthomosaic, volume estimation, and precise contour lines.

Given the above, the objective of this work was to establish a technical feasibility study for the use of multispectral sensors onboard an Unmanned Aerial Vehicle (UAV) to estimate the vigor classes of *Brachiaria ruziziensis* pastures.

II. MATERIAL AND METHODS

Study area characterization

The study area is located in the municipality of Coronel Pacheco, state of Minas Gerais, Brazil, more precisely in the José Henrique Bruschi Experimental Field (CEJHB) of Embrapa Dairy Cattle. Regarding the terrain, the municipality of Coronel Pacheco, MG, has 10% flat terrain, another 10% considered mountainous, and 80% undulating terrain. The maximum and minimum altitudes are 1,070 m and 409 m, respectively. The head of the city has an altitude of 484 m. The experimental area was at an altitude between 424 and 465 m. the soil in the area is predominantly a clayey-textured dystrophic yellow latosol (Figure 1).

According to the Köppen-Geiger climate classification, the municipality of Coronel Pacheco, MG, is located in a transition zone of climate classification Aw (tropical climate with a dry winter season) and Cwa (temperate humid climate with dry winter and hot summer). However, the Cwa-class predominates in the region of the municipality where the weather station of the National Institute of Meteorology (INMET) is located. Based on INMET climatological standards for the period from 1981 to 2010, the annual average air temperature is 21.4ºC and the average annual precipitation volume is 1620.6 mm. July (12.6 mm) and January (355.1 mm) are the months with the lowest and highest rainfall, respectively.

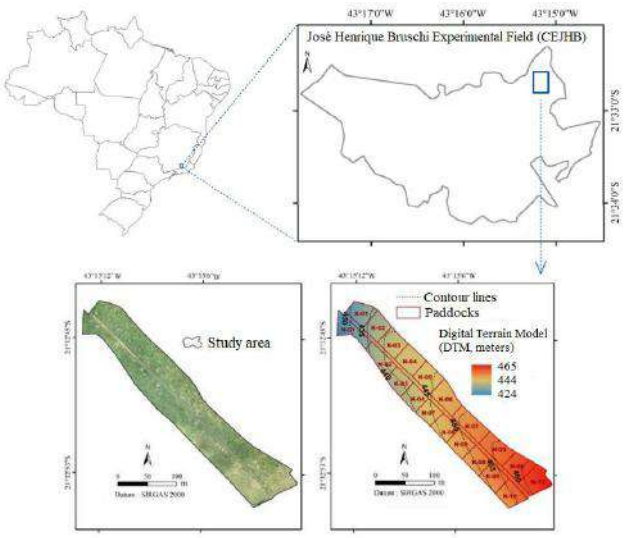


Fig. 1: Location of the study area highlighting contour lines, delimitation, and identification of Brachiaria ruziziensis experimental paddocks, municipality of Coronel Pacheco, Minas Gerais, Brazil.

Cultural practices and animal management

Grasses of the species *Brachiaria ruziziensis* (cv. BRS Integra and cv. Kenedy) were established in December 2017, in a 6-ha area. The soil was amended with limestone to raise the base saturation to 40%. After plowing and harrowing, forages were planted in rows spaced 40 cm, with a sowing density of 3.5 kg of viable pure seeds per hectare. At planting, a dose of 100 kg/ha of P_2O_5 was applied. Nitrogen and potassium were applied at a dose of 40 kg/ha, 50 days after planting. The area was split into two sub-areas. The first three hectares were intended for the management of reserve animals and the second, with also three hectares, was used in the conduction of the experiment.

The area under the management of the experimental animals was split into two 1.5-ha sub-areas, which were again split with an electric fence into 20 paddocks, 10 of which were used for each grass. Rotated stocking management was adopted and the switch-back experimental design for evaluating milk production was used. Grazing was carried out by Holstein x Zebu cows, during the rainy season (October to May) of 2017-2018 and 2018-2019. The average idle period was 18 days and the paddock occupation was of two days. The average heights of the forage canopy at the entrance and exit of the animals from the paddocks were 50 and 25 cm, respectively. The cows were provided by the herd owned by Embrapa Dairy Cattle. The pastures received annual doses of 200 kg/ha of N and K_2O and 50 kg/ha of P_2O_5.

Aerial surveys for generation of vegetation indexes

The aerial surveys were carried out on November 14, 2018, January 14, 2019, and May 13 2019 using a rotary-wing UAV, quadcopter-type, model Inspire 1 Pro and with the use of a Sentera Multispectral Double 4K Gimbaled – 5 band camera, according to the specifications shown in Table 1.

Table 1: Specifications of each band of the spectral range were obtained with the use of Sentera Multispectral Double 4K Gimbaled imaging

Bands	Wavelength center (nm)	Band width (nm)
Blue	446	60
Green	548	45
Red	650	70
NIR	720	40
Red Edge	840	20

The flight plans were carried out following standardized technical compliance, so that the results or products of the aerial survey could be compared on similar bases, equalizing variables such as flight height, pixel size of ground images (Ground Sample Distance - GSD), sensor calibration, percentage of image overlap, wind speed, brightness, shadow/sun positioning, time of day, angle of view, etc.

The flight plan was parameterized as follows: (i) flight height of 90 m; 2.60 cm GSD; maximum speed of 4.5 m/s, flight time of 20 minutes using two batteries; 75% lateral and frontal overlap of the images. Based on this flight plan configuration, 18 flight lines and 229 images were needed to cover the entire area and later generate the orthomosaic through processing in the Pix4D Mapper Pro 4.125 software.

Using the images containing the five spectral bands specified in Table 1 enables to perform the analysis of planting conditions through the application of vegetation indices. These indices can be an aid in the classification of the targets, for example, in the discrimination of vegetation growing within the normal range and planting areas with some type of deficiency [8].

This experiment used the VARI (Visible Atmospherically Resistant, [8]), GLI (Green Leaf Index, [9]), and CIgreen (Green Chlorophyll Index, [10]) indices. The indices NDVI (Normalized Difference Vegetation Index, [11]) and NDRE (Normalized Difference Red Edge, [12]) were also used.

$$VARI = \frac{\rho_{Green} - \rho_{Red}}{\rho_{Green} + \rho_{Red} - \rho_{Blue}} \quad \text{Eq. 1}$$

$$GLI = \frac{\left(2\,\rho_{Green} - \rho_{Red} - \rho_{Blue}\right)}{\left(2\,\rho_{Green} + \rho_{Red} + \rho_{Blue}\right)} \quad \text{Eq. 2}$$

$$CIgreen = \left(\frac{\rho_{nir}}{\rho_{green}}\right) - 1 \quad \text{Eq. 3}$$

$$NDVI = \frac{\rho_{nir} - \rho_{red}}{\rho_{nir} + \rho_{red}} \quad \text{Eq. 4}$$

$$NDRE = \frac{\rho_{nir} - \rho_{rededge}}{\rho_{nir} + \rho_{rededge}} \quad \text{Eq. 5}$$

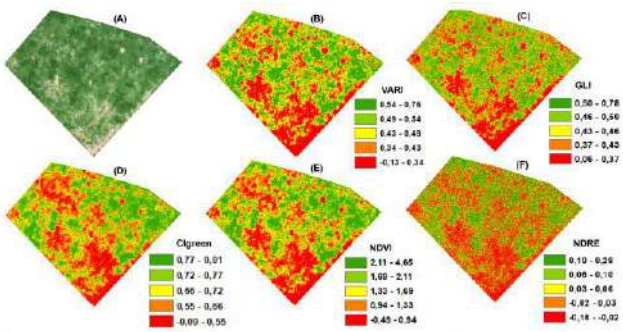
Where ρ_{Green}, ρ_{Red}, ρ_{Blue}, $\rho_{RedEdge}$ and ρ_{NIR} are the spectral bands corresponding to the Green, Red, Blue, Red Edge, and near-infrared (NIR) channels, respectively.

III. RESULTS AND DISCUSSION

Figures 2 and 3 show an RGB mosaic image (Figures 2A, 3A) and maps of the VARI (Figures 2B, 3B), GLI (Figures 2C, 3C), CIgreen (Figures 2D, 2D), NDVI (Figures 2E, 3E) indices and NDRE (Figures 2F, 2F) from the study area with grasses of the species *Brachiaria ruzizienis* (cv. Kenedy – paddock K-01 and cv. BRS Integra – paddock N-01), for November 14, 2018. Figure 2 shows a table with the range of classes of the indices and their respective estimates of area (ha) and percentage (%) of coverage concerning the total area of the paddock.

The VARI is an index whose formulation seeks to reduce possible influences of atmospheric constituents. The GLI index has been applied to distinguish between photosynthetically active vegetation and dry vegetation with soil exposure. CIgreen seeks to highlight aspects relevant to green vegetation. Originally developed to enhance herbaceous-shrubby vegetation, the NDVI is one of the most used indices in different vegetation studies. On the other hand, the NDRE has been used to distinguish shades between forages with different vigor conditions and the noise represented by the soils.

The Natural Breaks (Jenks) algorithm was used to establish the ranges of vegetation index values classes, in which five classes were defined represented by two palettes in shades of green (dark and light) and another three in the colors of yellow, orange, and red. The color palettes in shades of green represent the plants ranked with the highest values of the vegetation indices.



Classes/ Indices	VARI		GLI		CIgreen		NDVI		NDRE	
	Area (m²)	Coverage (%)	Area (m²)	Coverage (%)	Area (m²)	Coverage (%)	Area (m²)	Coverage (%)	Area (m²)	Coverage (%)
	300,3	21,53	298,2	21,38	281	20,15	282,4	20,25	281	20,14
	275,6	19,76	286,1	20,52	274,1	19,65	270,4	19,39	308,7	22,13
	274,7	19,69	222,2	15,93	279,7	20,06	267,7	19,2	236	16,92
	257,3	18,45	307,8	22,07	282,7	20,27	294,9	21,15	71,37	5,11
	286,5	20,54	280	20,07	276,8	19,85	278,9	20	497,4	35,67

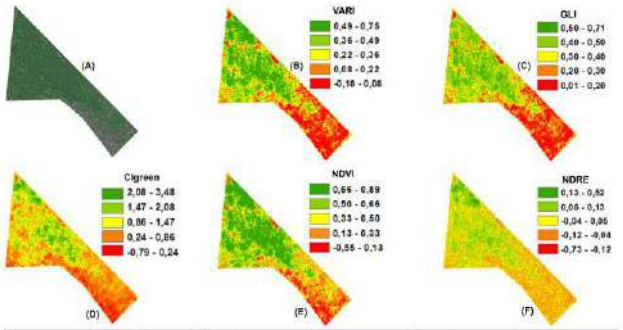
Fig. 2: RGB mosaic image (A) of the Brachiaria ruzizienses - cultivar Kennedy K-01 paddock area with and maps of vegetation indices: VARI (B), GLI (C), CIgreen (D), NDVI (E), and NDRE (F), for November 14, 2018.

Plants with greater vigor (shades of green) were classified as 41.29%, 41.90%, 39.80%, 39.64%, and 42.27% of the *Brachiaria ruzizienses* - cultivar Kennedy paddock area by the VARI, GLI, CIgreen, NDVI, and NDRE indices (Figure 2), respectively. On the other hand, in the low vigor class represented by the red color palette, the VARI, GLI, CIgreen, NDVI, and NDRE indices showed covers of 20.54%, 20.07%, 19.85%, 20%, and 35.67 %, respectively.

Regarding cultivar BRS Integra from the N-01 paddock, (Figure 3), about 46.48%, 41.20%, 21.57%, 55.68%, and 33.97 of vegetation cover were classified as plants with greater vigor (shades of green) when VARI, GLI, CIgreen, NDVI, and NDRE indexes were applied, respectively. In this case, according to the index used, a large percentage of difference is observed in the estimates of greater-vigor vegetation cover.

According to established intervals, the CIgreen and NDRE indices were those with the lowest percentage of area defined as a vigorous plant-class (dark green class), in which plants classified as intermediate predominated. On the other hand, the NDVI index had greater saturation, that is, it was less sensitive in discriminating classes with high vigor and, therefore, it overestimated the coverage percentage of this class of plants (Figure 3).

Figure 4 shows a cutout area of the K-01 paddock (cv. Kennedy) that exemplifies the sensitivity of the NDRE (Figure 4A) and CIgreen (Figure 4B) indices. The CIgreen index showed good sensitivity in identifying vegetation stresses, however, it did not demonstrate the sharpness, detail, and separation of classes offered by the NDRE (Figure 4A). This fact is observed when comparing the regions highlighted in circles in Figures 4A and 4B.



Classes/Indices	VARI		GLI		CIgreen		NDVI		NDRE	
	Area (m²)	Coverage (%)	Area (m²)	Coverage (%)	Area (m²)	Coverage (%)	Area (m²)	Coverage (%)	Area (m²)	Coverage (%)
	310	21,41	126,8	8,76	55,89	3,86	437,5	30,22	59,07	4,08
	363	25,07	469,7	32,44	256,4	17,71	368,6	25,46	432,8	29,89
	270,3	18,67	328,1	22,66	481,4	33,25	284,9	19,68	602,9	41,64
	273,8	18,91	287,7	19,87	543,9	37,57	251,3	17,36	302,5	20,89
	230,9	15,95	235,6	16,27	105,8	7,31	105,4	7,28	50,67	3,5

Fig. 3: RGB mosaic image (A) of the Brachiaria ruzizienses - cultivar BRS Integra N-01 paddock area and maps of the vegetation indices: VARI (B), GLI (C), CIgreen (D), NDVI (E), and NDRE (F), for November 14, 2018.

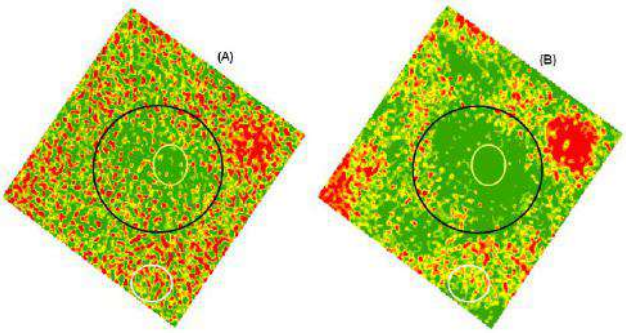


Fig. 4: Cutout of the K-01 paddock (cv. Kennedy) area exemplifying the detection sensitivity of the NDRE (Figure 4A) and CIgreen (Figure 4B) indices.

Figure 5 shows RGB mosaic and the application of the NDVI (Figures: 5B, 5E) and NDRE (Figures: 5C, 5F) indices of *Brachiaria ruziziensis*, cultivars Kennedy (Paddock K-06: Figures: 5A, 5B, 5C) and BRS Integra (Paddock: N-06: Figures: 5D, 5E, 5F), on January 14, 2019. It is observed that the NDRE index was able to distinguish details in the scene.

In comparison to the NDVI, the NDRE detected a slightly higher percentage of more vigorous plants, approximately 2%, represented by classes in shades of green. It detected a lower percentage of stressed plants and non-plants (exposed soil, animal feces, and others), with approximately 2.5%, represented by classes in yellow and reddish shades. The greatest difference observed between

them, approximately 15% greater, is because of the classification of dead plants and non-plants, represented by the red class. However, it is observed that the sum of the orange and red classes, which represent highly stressed plants (with difficult recovery) and non-plants, had percentage estimates of around 40%. The presence of leafhoppers (*Deois flavopicta* - Hemoptera: Cercopidae) significantly impacted the area cultivated with *Brachiaria ruziziensis* and caused a reduction in vigor and, consequently, in the expected production capacity.

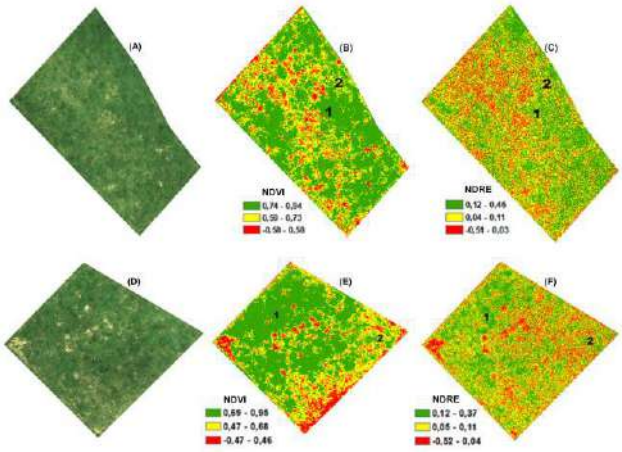


Fig. 5: RGB mosaic image (Figures 5A, 5D) and maps of the NDVI (Figures: 5B, 5E) and NDRE (Figures: 5C, 5F) indices of Brachiaria ruziziensis, cultivars Kennedy (Paddock K-06: Figures: 5A, 5B, 5C) and BRS Integra (Paddock: N-06: Figures: 5D, 5E, 5F), corresponding to the aerial survey carried out on January 14, 2019.

Figures 6, 7, and 8 show RGB mosaics (Figures 6A, 7A, 8A; 6D, 7D, 8D) and the NDVI index maps (Figures: 6B, 7B, 8B; 6E, 7E, 8E) and NDRE (Figures: 6C, 7C, 8C; 6F, 7F, 8F) of *Brachiaria ruziziensis*, corresponding to the aerial survey carried out on May 6th (Figure 6) and 13th (Figures 7 and 8) of 2019.

The indices point to a spatiotemporal heterogeneity of development of *Brachiaria ruziziensis* within each paddock area with cultivars Kennedy and BRS Integra. In this case, several factors may have influenced, such as conditions of the water, grazing, chemical, and physical soil constituents, and pest attacks such as leafhoppers. In this case, it is clear that the vegetation indices can help to identify areas of the plantation that present development within the normal range or with some deficiency. According to Hunt Jr. et al. [9], vegetation indices have fundamental application in extracting information from remote sensing data, however, these methods may reduce, but not eliminate, the effects of soils, topography, and angle of view.

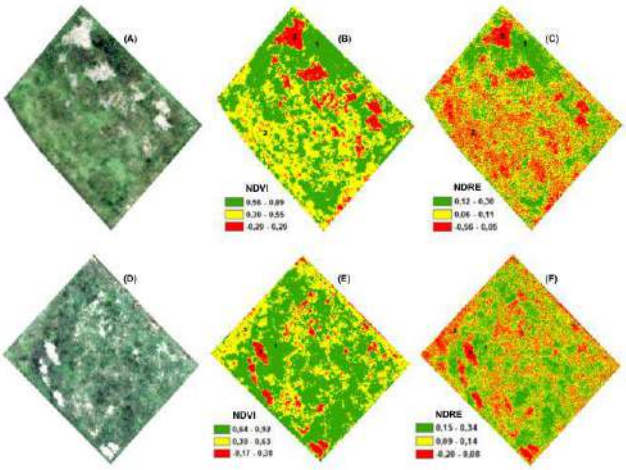


Fig. 6: RGB mosaic image (Figures: 6A, 6D) and maps of the NDVI (Figures: 6B, 6E) and NDRE (Figures: 6C, 6F) indices of Brachiaria ruziziensis, cultivars Kennedy (Picket K-03: Figures: 6A, 6B, 6C) and BRS Integra (Picket: N-03: Figures: 6D, 6E, 6F), corresponding to the aerial survey carried out on May 6, 2019.

The NDRE is more efficient in discriminating or interpreting plant conditions from the intermediate stage of development, that is, when the plant accumulates a large number of overlapping leaves. This index better captures the reflectance of the lower layers of the canopy leaves that are photosynthetically active. In this case, the explanation for the better NDRE sensitivity when compared mainly to NDVI (Figures 6, 7, and 8) is the fact that the red band is better absorbed by the leaves for photosynthesis in comparison to the red edge band (Red Edge).

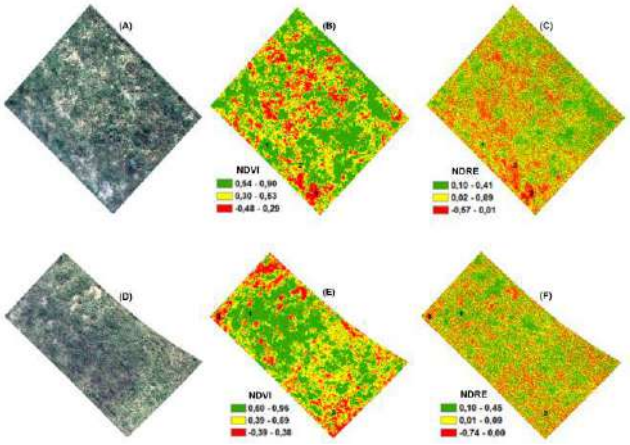


Fig. 7: RGB mosaic image (Figures: 7A, 7D) and maps of the NDVI (Figures: 7B, 7E) and NDRE (Figures: 7C, 7F) indices of Brachiaria ruziziensis, cultivars Kennedy (Paddock K-05: Figures: 7A, 7B, 7C) and BRS Integra (Paddock: N-03: Figures: 7D, 7E, 7F), corresponding to the aerial survey carried out on May 13, 2019.

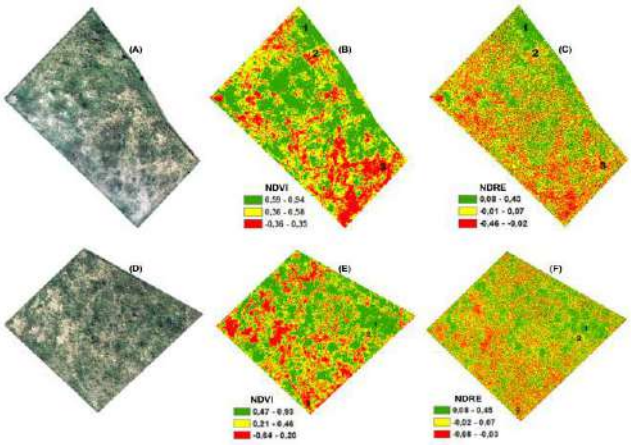


Fig. 8: RGB mosaic image (Figures: 8A, 8D) and maps of the NDVI (Figures: 8B, 8E) and NDRE (Figures: 8C, 8F) indices of Brachiaria ruziziensis, cultivars Kennedy (Paddock K-06: Figures: 8A, 8B, 8C) and BRS Integra (Paddock: N-06: Figures: 8D, 8E, 8F), corresponding to the aerial survey carried out on May 13, 2019.

In general, the color of the leaf varies according to the percentage of reflectance of the chlorophyll pigment and the absorbance of visible light in the red, green, and blue spectrum ranges, that is, in the RGB range. However, there are light spectrum bands such as the RedEdge that are more accurate or sensitive to the presence of chlorophyll pigments in the plant. Furthermore, just as near-infrared is widely used in the indication of nitrogen in leaves, the red edge has been very accurate in identifying the variability of nitrogen in leaves. In this context, the use of the NDRE index has great potential for mapping the variability of leaf nitrogen, aiming, for example, for greater efficiency in the application of fertilizers.

IV. CONCLUSION

The indices showed good performance and sensitivity in class discrimination at intervals that point to from soil exposure and stresses caused by pests and disease infestation (low vigor) to conditions in which the vegetation is at a good development, in class intervals with high levels of vegetation and, consequently, indicating high values of biomass. Furthermore, it was observed that the NDRE index has greater sensitivity in identifying shades of vegetation vigor, demonstrating greater clarity and detail in the discrimination of plants under stress conditions.

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Effect of Electric Cigarette Smoke Exposure on Spermatozoa quality of mice (*Mus musculus* L)

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Keywords*— *E-cigarette, Spermatozoa quality, mice.

***Abstract*—** *E-cigarette is one of the cigarettes that many used. E-cigarette smoke can cause disturbance in reproduction system. Chemical contents in e-cigarette smoke can increase free radicals that can cause oxidative stress. This purpose of this study to know the effect of e-cigarette smoke exposure to spermatozoa quality of mice (Mus musculus* L*). The tested animal were divides into 4 groups, every group consists of 6 mice that given treatment that is e-cigarette smoke exposure with a volume of L ml, 2 mL, and 4 mL for 4 weeks. Nicotine content in e-cigarette liquid was 6mg/mL. The parameter observed were percentage of motility and abnormal spermatozoa morphology. The conclusion of this study is e-cigarette smoke exposure decreased spermatozoa quality that is increased abnormal spermatozoa morphology in the treatment of e-cigarette liquid volume of 2 mL and 4 mL, meanwhile in spermatozoa motility is tend to decrease.*

I. INTRODUCTION

Cigarettes are one of the tobacco products that can cause health problems and even death for humans. E-cigarettes cause disorders of the respiratory system, cardiovascular system, hormonal imbalances, cancer and disorders of the reproductive system (Szumilas *et al.*, 2020). E-cigarettes are tools used by smokers to vaporize the liquid of an electric cigarette and the resulting vapor resembles tobacco smoke. This e-cigarette consists of several parts, namely the *battery* (the part that contains the battery), the *atomizer* (the part that heats and evaporates the nicotine and propylene glycol solution) and the *cartridge* (contains the e-cigarette liquid) (Electronic Cigarette Association, 2009). The chemical content of e-cigarette smoke causes an increase in free radicals which will cause oxidative stress (Sari, 2014). El Golli *et al.* (2016), Wistar rats that were treated with an e-cigarette liquid at a dose of 0.5 mg nicotine/kg BW/day intraperitoneally (IP) for 4 weeks could increase oxidative stress by producing ROS due to decreased testicular lactate dehydrogenase activity. In addition, there is also interference with steroidogenesis and spermatogenesis.

E-cigarette liquid contains nicotine, water, propylene glycol, glycerol, and flavoring agents (Oroh *et al.*, 2018). Based on research conducted by the US *Food and Drug Administration* (FDA) in 2009, e-cigarette smoke contains *Tobacco Specific Nitrosamine* (TSNA) and *Diethylene Glycol* (DEG) which are toxic and carcinogenic (Alawiyah, 2017). Further research is needed regarding the effect of exposure to e-cigarette smoke on the quality of spermatozoa in male mice *(Mus musculus* L*),* including motility and abnormal spermatozoa morphology.

II. MATERIALS AND METHODS

2.1 Material of research

The materials used in the study were male mice (*Mus musculus* L) obtained from the the Center for *Veterinary*

Farma (Pusvetma), Surabaya, broiler pellet feed (BR1 Plus), the liquid used for electric cigarettes with strawberry

oatmeal flavor containing a dose of 6 mg of nicotine per mL, distilled water, chloroform, 0.9% NaCl, 2% formalin, Eosin as dye and entelan.

2.2. Procedure of research

Mice were divided into 4 groups, each using 6 mice as repetitions. Group 1 (without exposure to e-cigarettes smoke), group 2 (exposure to electric cigarette smoke with a liquid volume of 1 mL), group 3 (exposure to electric cigarette smoke with a liquid volume of 2 mL), and group 4 (exposure to e-cigarette smoke 4 ml). E-cigarette liquid contains 6 mg nicotine/mL. Exposure to e-cigarette smoke in group 2 was done once, in group 3 it was done twice, while group 4 was 4 times. After each exposure, the mice were rested for 15 minutes until the smoke disappeared and then proceeded to the next exposure. Exposure to cigarette smoke was carried out for 4 consecutive weeks by inhalation in a vaping box (El Golli *et al.*, 2016). Test animals were killed on day 28, one hour after the last treatment. Mice were anesthetized using chloroform before surgery to remove the epididymis. The left cauda epididymis was put into a watch glass containing 0.9% NaCl solution to observe sperm quality.

Spermatozoa quality observations were carried out to determine the motility and morphology of mice spermatozoa. Spermatozoa quality observation methods were as follows:

a. Spermatozoa Motility

Spermatozoa suspension (cement) in 0.9% NaCl was taken with a pipette and one drop of suspension was placed on a hemacytometer then covered with a cover slip and observed under a microscope with a magnification of 400 times. Spermatozoa calculation was carried out from one field of view on ±300 spermatozoa and then classified to produce the percentage of each motility category. Category motility was as follows:

1) Category 0 = sperm do not move at all
2) Category 1 = spermatozoa moving very slowly
3) Category 2 = spermatozoa moving forward with moderate speed / moving zig-zag and swirling
4) Category 3= spermatozoa move straight fast forward .

Percentage of motility of spermatozoa was determined by the formula:

$$\% \text{ motility} = \frac{\text{kategori } 2+3}{\text{kategori } 0+1+2+3} \times 100\%$$

(Soehadi and Winarso, 1987).

b. Abnormal spermatozoa morphology

The cement suspension was placed one drop on an object glass, then 2% formalin was added and dried. After that, one drop of 1% Eosin was given and then rinsed with distilled water and then covered with a cover glass and cooled down. Further observations under microscope with a magnification of 400 times (Arsyad and Hayati, 1994).

Observations were made on 3 fields of view, counted the number of normal spermatozoa and abnormalities of spermatozoa which include abnormalities of the head, middle and tail (Arsyad and Hayati, 1994). Observation results are expressed in percentage with the formula:

$$\% \text{ abnormal} = \frac{\text{Jumlah spermatozoa abnormal}}{\text{Jumlah spermatozoa normal+abnormal}} \times 100\ \%$$

(Toelihere, 1993)

III. RESULTS AND DISCUSSION

The average percentage of sperm motility and morphology of abnormal spermatozoa in mice after exposure to e-cigarette smoke is presented in Table 1.

Table 1. Motility and abnormal spermatozoa morphology of Mice (*Mus musculus* L) after exposure to e-cigarettes

E-cigarette liquid volume	Spermatozoa motility (%) ($\bar{x}$ ± SD)	Abnormal spermatozoa morphology (%) ($\bar{x}$ ± SD)
Control	25.03 ± 9.55	50.56^{a} ± 9.50
1 mL	24.73 ± 13.10	55.01^{ab} ± 5.81
2 mL	22.25 ± 10.79	59.48^{b} ± 4.33
4 mL	13.94 ± 7.71	60.95^{b} ± 4.75

Note: Numbers in the same column followed by the same letter show no significant difference)

The results of One Way Anova test, a significance value of p = 0.253> 0.05 was obtained on the motility of spermatozoa. This indicates that exposure to e-cigarette smoke does not significantly affect the motility of spermatozoa. However, the higher the volume of e-cigarette liquid used, the lower the average sperm motility of mice.

The results of One Way Anova test on the average morphology of abnormal spermatozoa obtained a value of F = 3.199 with a significance of p = 0.045 <0.05. This

shows that the volume of e-cigarette liquid has a significant effect on the morphology of abnormal spermatozoa. The results of the Duncan Multiple Range Test (DMRT) = 0.05 showed that the control was not significant with 1 mL e-cigarette liquid volume and significant with 2 ml and 4 ml e-cigarette liquid volumes. This shows that the administration of e-cigarette liquid with a volume of 2 mL and 4 mL has increased the percentage of abnormal spermatozoa morphology. This is presumably because the increased nicotine content causes an increase in free radicals.

In this study, the administration of e-cigarette smoke did not significantly affect the motility of spermatozoa although the motility of spermatozoa decreased with increasing dose. The decrease in spermatozoa motility is thought to be due to the influence of free radicals generated by e-cigarette smoke inhibiting oxidative phosphorylation in obtaining energy. Mitochondria are cell organelle that functions to produce energy (ATP) (Fitriani *et al*., 2010). Mitochondria are targets for nicotine because they have nAChRs (Nicotinic Acetylcholine Receptors). Binding between nicotine and nAChRs might increase ROS, thereby reducing ATP production. The main source of reactive oxygen compounds (ROS) in cells also comes from the mitochondrial electron transport chain. Based on this, the decrease in spermatozoa motility occurred due to the decrease in ATP caused by the production of ROS by binding of nicotine to nAChRS. The motility of spermatozoa is influenced by the energy produced by the mitochondria in the neck of the spermatozoa (Bourgeron, 2000). According to Susmiarsih (2010), decrease in the quality (decrease in motility) of spermatozoa is caused by oxidative stress on spermatozoa so that it can inhibit the production of ATP produced by the mitochondria of spermatozoa through oxidative phosphorylation.

The motility of spermatozoa is highly dependent on the supply of energy in the form of ATP as a result of metabolism. Spermatozoa mitochondria located in the midpiece of spermatozoa function to produce energy (ATP), while the principal piece and end piece function in the movement of spermatozoa. ATP that has been synthesized in the mitochondria is transported to the axoneme at the tail of the spermatozoa, then converted by dynein (ATPase enzyme) in the axoneme which will decompose ATP into energy for the movement of spermatozoa. The inhibition of the release of ATP to the axoneme results in unfulfilled or reduced energy requirements to move the tail, which in turn results in reduced motility of spermatozoa or does not move at all (Astuti *et al*., 2009).

ROS also causes an increase in abnormal spermatozoa morphology. In this study, the morphology of abnormal spermatozoa increased with increasing dose. It is suspected that high ROS levels can cause damage to spermatozoa membranes. According to Sanocka *et al*. (2004), the plasma membrane of spermatozoa contains high levels of phospholipids, causing spermatozoa to be very susceptible to ROS. This indicates that spermatozoa membranes are the main target of ROS and lipids are potential targets (Lamirande *et al*., 1997). Lipid oxidation (lipid peroxidase) in spermatozoa membranes produces malondialdehyde (MDA) compounds, which are toxic to cells, causing damage to spermatozoa membranes. According to Susilawati (2011), the function of the membrane is to protect the cell. Damage to the spermatozoa membrane causes a decrease in the integrity of the spermatozoa membrane and disrupts intracellular metabolic processes, which in turn causes a decrease in sperm quality and even death of spermatozoa. Damage to the spermatozoa membrane causes disruption of cell metabolism, thereby increasing the morphology of abnormal spermatozoa.

In this study, primary and secondary abnormalities were found. The primary abnormalities found in this study included forked head while the secondary abnormalities found in this study included a twisted tail, a bent tail, a bent neck, and a severed tail. Morphology normal and abnormal spermatozoa in mice found in this study can be seen in figure 1.

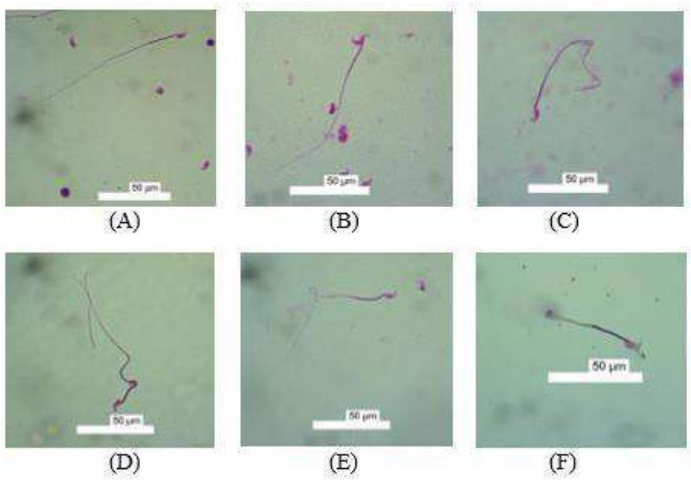

Fig.1. Morphology of normal spermatozoa (A), primary (B) and secondary (C - F) abnormalities with 400x microscope magnification

Primary abnormalities occur in the testes due to impaired function of Leydiq cells in producing testosterone. Testosterone is needed in the process of spermatogenesis (Garner and Hafez, 2000). Secondary abnormalities occur in the epididymis. Disruption of Leydiq cells also interferes with the sperm maturation process because if

testosterone is reduced, the epididymal epithelium will thin so that the compounds needed in the maturation process are reduced (Zhan *et al*., 2012).

IV. CONCLUSION

Exposure to e-cigarette smoke decreased the sperm quality of mice by increasing the morphology of abnormal spermatozoa in the 2 mL and 4 mL e-cigarette fluid volume treatment, while the motility of spermatozoa tended to decrease.

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Public Policies for Cooperation on Water Supply and Water Allocation between the Municipalities of Bombinhas and Tijucas, Santa Catarina State, Brazil

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***Keywords*—Cooperation, Municipality, Public Policy, Water Supply, Water Allocation.**

***Abstract*—** *The rational use of water is a concern in several countries that face severe water crises, both due to lack of treatment and water itself. The objective of this study is to analyze the public policies of cooperation for water allocation and supply between the municipalities of Tijucas and Bombinhas, located in the State of Santa Catarina, Brazil. Primary and secondary data were used regarding the Public Policies applied in the cooperation of water use between the municipalities. The primary data were collected through a bibliographic survey, document analysis that supported the transaction in reference, and legislative consultation that provided the legal apparatus of this Grant. The secondary data was obtained through semi-structured interviews. According to studies carried out by Águas de Bombinhas, the amount of water authorized for catchment by Secretaria de Estado de Desenvolvimento Econômico e Social - SDE (250L/s) is sufficient for the hydric supply of the city, during low or high seasons, until 2049. Despite the quantity of water being sufficient for the existing demand, more than half of the interviewees, residents of the city of Bombinhas/SC, report that the lack of water is still recurrent. On the other hand, 60% affirm that the price charged by the company is considered fair, considering the service offered.*

I. INTRODUCTION

Water has a fundamental importance in maintaining biodiversity (Bacci and Pataca, 2008; Pulido, 2015; Pes, 2019). The presence or absence of water creates habits, develops cultures, determines land use occupation, wins battles, and drives new generations (Bacci and Pataca, 2008).

The Water Resources available for human consumption on the planet are tiny, despite the approximately 1,386 km3 billion of water, 97.5% of which is composed of saltwater distributed among oceans, saline aquifers and salt lakes (Clark and King, 2005; Agência Nacional das Águas - ANA, 2021). Only 2.5% is freshwater, but 2/3 is not available for consumption, as it is contained in glaciers, frozen subsoils, snow, among others (ANA, 2021).

Understanding the importance of water makes evident the constitutionally normed fundamental right to life because without this resource there is no possibility of human existence (Macedo, 2010; Pulido, 2015; Pes, 2019).

By fundamental right, it is understood that which is innate of every individual. Due to constitutional supremacy, it has immediate application, constituting a

stony clause and cornerstone that underlies the dignity of the human person, where it establishes an existential minimum to man (Franceschina and Mozetic, 2015; Pes, 2019).

It occurred in the year 2015, at the UN headquarters (New York), a meeting of the Sustainable Development Summit, from which, new Goals for Sustainable Development, called SDGs, were established, providing a global work agenda in the next 15 years, defined as Agenda 2030 for sustainable development (Sousa, 2018).

In this line, water has gained a new status: that of Sustainable Development guideline, through SDG 06 (Drinking Water and Sanitation). SDG 6 has 08 goals to be achieved within the 2030 agenda, aiming to provide universal and equitable access to drinking water for all, among other purposes (Programa das Nações Unidas para o Desenvolvimento – PNUD and Instituto de Pesquisa Econômica Aplicada - IPEA, 2021).

Concerning the amount of water available for consumption, Brazil has 14% of the total fresh water on the planet (Vargas and Azevedo, 2004; Wolkmer and Pimmel, 2013), is the largest reserve (Senado Federal, 2014), despite the abundance, its distribution is not uniform, being 80% found in the Amazon region (ANA, 2011; Empresa Brasileira de Comunicação - EBC, 2021).

In Santa Catarina, 97.19% of the population has treated water supply (Associação Brasileira das Concessionárias Privadas de Serviços Públicos de Água e Esgoto – ABCON and Sindicato Nacional das Concessionárias Privadas de Serviços Públicos de Água e Esgoto - SINDCON, 2019), but 200 thousand inhabitants still do not have this benefit (Instituto Brasileiro de Geografia e Estatística - IBGE, 2019). The State in the high season periods (December - February) receives a high tourist contribution attracted by its scenic features, scenic beauty and biodiversity (PRADO *et al*., 2012; Walkowski *et al*., 2017). In some regions, as in Bombinhas/SC, the number of visitors can increase up to 220%, when compared to the low season (Águas de Bombinhas, 2017).

Due to the high demand and insufficient Water Resources, it forced the municipality to hire tanker trucks to complement the water supply (Águas de Bombinhas, 2017a; 2021). Considering the water scarcity, the Water Supply Grant is a solution.

The Water Concession Grant is the instrument by which, the public authority, grants authorization to the public or private interested party the right to use Water Resources, for a determined period, under the terms and conditions expressed in the act (Granziera, 2001; ANA, 2011; 2013; Almeida and Curi, 2016; Cessa and Rizzi, 2017; Lisboa *et al*., 2019). To supply the demand, Bombinhas has requested a Grant of Passage from the Municipalities of Tijucas and Porto Belo, to abstract water from the Tijucas River. The Tijucas River watershed is the largest in the Central Coastal Hydrographic Region, has a drainage area of 2,371 km² and a drainage density of 1.68 km/km² (Comitê Tijucas Biguaçu, 2019).

Analyzing the cooperation entered into between the municipal entities, the intimate connection of Public Policies in the transaction in reference is verified. No matter the origin, whether they come from the State or social movements, Public Policies make values explicit and give publicity to the priorities of individuals or groups, since it is how society shapes the yearnings (Barata, 2013; Fernandez and Pietrafeza, 2021).

Considering the request for a water allocation from Bombinhas to the Municipality of Tijucas for the abstraction of water from the Tijucas River, we ask the following questions: In the context of the Public Policy of sharing, the cooperation of Grant and supply between municipal entities is an alternative for the solution of water scarcity?

II. MATERIALS AND METHOD

2.1 Study Area

Located on the northern coast of the State of Santa Catarina, the municipality of Bombinhas is limited to the North, East and South with the Atlantic Ocean and to the West with the Municipality of Porto Belo and has as geographical coordinates: Latitude 27º09'36" S and Longitude 48º32'32" W, from the Equator and the Greenwich Meridian respectively (Bombinhas, 2010).

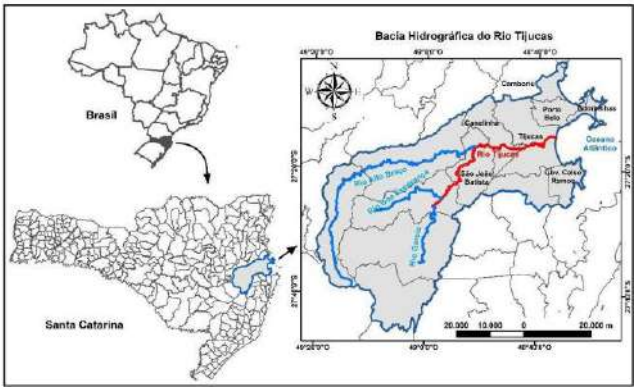

Fig.1. Tijuca's River Basin

Source: Fig. elaborated by the authors.

The Municipality of Tijucas, on the other hand, is also located on the North Coast of the State of Santa Catarina, bordering to the North with Camboriú, Itapema and Porto Belo, to the South with Governador Celso Ramos, to the

East with the Atlantic Ocean and West with Canelinha (Tijucas, 2020) and has as geographical coordinates (Fig. 01): Latitude 27º14'26" S and Longitude 48º38'4" W, from the Equator and the Greenwich Meridian, respectively (Cidade Brasil, 2019).

2.2 Data Collection

To conduct the research, primary and secondary data were used regarding the public policies applied to the capture and supply of water between the municipalities of Bombinhas and Tijucas, SC. The primary data were collected using a bibliographic survey and the current legislation referring to the Granting in Brazil, Santa Catarina and the Municipalities of Bombinhas and Tijucas.

The secondary data were collected using semi-structured interviews, using a script with 23 questions for people from the community and ten for the municipal authorities, focusing on the supply of treated water in the Municipalities of Tijucas and Bombinhas. Questions were asked about the community's knowledge, concerning the Granting and supply that occurred between the transacting Municipalities, as well as specific knowledge concerning the origin of the water resource they consume. We interviewed 50 residents from Tijucas and another 50 from Bombinhas, and 10 authorities in each municipality.

2.3 Data Analysis

After collecting primary data, the information was categorized and tables were prepared. After collecting the secondary data were organized in spreadsheets and interpreted through the use of tables.

III. RESULTS AND DISCUSSION

3.1 Grant for water supply

The Grant is a legal instrument used in water management in the country, effective with the enactment of Federal Law No. 9.433/97 (Brasil, 1997), which established the National Water Resources Policy. The need for Grant occurs, for any use that changes the regime in the quality or quantity existing in the catchment site (Garcia *et al*., 2007; Cessa and Rizzi, 2017; Lisboa *et al*., 2019).

The definition of criteria for the Grant obligatorily goes through the analysis/study of a reference value of the competent body, which determines the upper limit of use (Pereira, 1996; Lisboa *et al*., 2019). However, according to Santos (2009), there is no uniformity regarding the type of Grant adopted in Brazil. The predominant model has as a standard, the establishment of a minimum flow rate in the water body, without concern about the losses of quantity or the possibility of using the excess water (Almeida and Curi, 2016). Despite having a specific character, the Grant waives regional analysis and should be guided by plans of Water Resources, land use and possible environmental impacts at the watershed level, defined through its committee (Conejo, 1993; Lisboa *et al*., 2019).

The problem plaguing the Watershed Committees is that community participation, as integral members, generates a favourable/positive perspective for the realization of sustainable ways of life in the watersheds, but that, there is still no effective participation of local citizens. One of the problems is that people are adapted to the paternalistic culture of the State, and the solution of conflicts must be instituted by the President, Governor, Mayor, in the conception that these are the only ones responsible for the implementation of Public Policies (Santos, 2009; Miranda, 2017; Silva and Teixeira, 2018).

The logic of a collegiate responsible for the watershed enables the participation of numerous social actors, generating a decision that passes through the sieve of people with different visions, helping to settle existing conflicts based on a reference to be worked (Presidência da República, 1997; Malheiros *et al*., 2013; Silva and Teixeira, 2018).

In Brazil, since the implementation of the National Water Resources Policy to date, the total number of water use permits granted by the National Water Agency (ANA) is 32,249, an agency that has the authority to manage the federal or interstate basin committees (ANA, 2021).

Analyzing the numbers by region, we can see that the Northeast Region has the most Granting Authorizations, accounting for 42.75%, followed by the Southeast Region 41.12%, Center-West Region 6.62%, North Region 5.80% and South Region 3.71%. The demand for the use of water is varied, according to data from a report prepared by the ANA, irrigation is responsible for 68.4% of the use of the captured water, followed by animal use which represents 10.8%, industry 8.8%, urban supply 8.6%, rural supply 2.4%, mining 0.8% and finally, thermoelectric 0.2% (ANA, 2017).

If we analyze Spain, some points are identical to the national Grant indexes, and in 2002, the following purposes were ascertained: Irrigation 63.8%, human supply, 11.4%, industry 5.9%, among others (Briz, 2018).

Santa Catarina, compared to the national level, had 118 Grant granted by ANA, being the 6th State with the smallest number of concessions. The reason for the low number may be related to the small number of watersheds under the domain of the Union, only 5, being the Rivers: Mampituba, Negro, Peperi-Guaçú, Pelotas and Canoas (Secretaria de Estado de Desenvolvimento Econômico e Social - SDE, 2014).

The state has a total of 18 hydrographic basins, 11 of which are isolated basins that flow eastward, flowing directly into the ocean and are part of the Atlantic Ridge, and 07 belong to the integrated system of the Interior Ridge, which is part of the Paraná-Uruguai basin. (SDE, 2014). In the State of Santa Catarina, the issuing of the Grant is a competence of the State Department of Sustainable Economic Development (SDE), through the Water Resources Board (ANA, 2021a), until 2019, the acronym was SDS. Granting must also obey the criteria defined by the Watershed Management Committees, more specifically its Water Resources plan (Comitê Tijucas Biguaçu, 2019).

In the state, since the promulgation of the Federal Law 9.433/97 (Brasil, 1997), the State Department of Sustainable Economic Development has granted until 2020, 3.447 concessions (ANA, 2021a). Among the total 2,839 refer to underground capture - 82.36% and 608 to surface capture - 17.64%. However, Ribeiro et al. state that the use of surface water is considered a priority over groundwater and should be used only when there is no other possibility of surface water supply (Ribeiro *et al*., 2014; França *et al*., 2018).

As an example, we use the city of Rio Verde/GO, belonging to the micro-basin of Ribeirão Abóbora. From the total amount of water captured through Grant, to supply the public system, 83% comes from the surface catchment and the remaining 17% represents underground catchment (Garcia *et al*., 2007), the percentage is similar to the Grants granted in Ceará (França *et al*., 2018). In Spain, the exploitation of groundwater is above its use capacity, but the extrapolation is due to the water shortage that the country faces at certain times of the year (Ceará, 2017).

Moving on to make a comparison of the purposes of the request for Granting in Brazil, the irrigation activity represents 58.77%, while in Santa Catarina 3.74%. The segment that most requested Granting was for animal husbandry 30.81%, public supply 13.34%, industry 11.28% and mining 3.19%. The disparity at a national level is that Santa Catarina has a predominance in the cattle-raising branch.

Despite the large number of water concessions granted in the State of Santa Catarina, when interviewing the community of Tijucas, 100% declared that they did not know of any public policy for water concessions in the country. The population of Bombinhas, on the other hand, 97.5% said they did not know and 2.5% chose not to answer. Concerning the authorities of the municipality of Tijucas, 80% declared they did not know and 20% chose not to answer the questionnaire. In Bombinhas, on the other hand, 90% declared they had no knowledge and 10% did not answer.

Among the 3,447 concessions granted in the state, 71 refer to concessions in municipalities belonging to the Tijucas River Basin: (Upper Valley) Angelina 10, Rancho Queimado 05, Leoberto Leal 01, Major Gercino 02; (Middle Valley) Nova Trento 04, São João Batista 08, Canelinha 02; (Lower Valley) Tijucas 11, Itapema 01, Porto Belo 05, Bombinhas 03, Governador Celso Ramos 01 and Biguaçu with the total of 18. The quantity represents 2.05% of the Granting in Santa Catarina, the rest being distributed among the other watercourses. And, among the grants granted to entities belonging to the Tijucas River Watershed, is the concession granted to the Municipality of Bombinhas, through Grant Ordinance No. 166 of 06/30/2017; Process No. DSUST 00000670/2017, requested on 04/06/2017, with a term of validity from 06/30/2017 to 06/30/2027 (10 years), for water withdrawal from the Tijucas River for public supply of the applicant municipality.

Table 01. Responses of interviewees in the municipalities of Tijucas/SC and Bombinhas/SC - Community and Authorities.

QUESTIONS		TIJUCAS			
Does the Grant represent an environmental risk?		**No**	**Yes**	**Did not answer**	**Total**
	N	33	7	---	40
	%	82,5	16,5	---	100
Were you aware of the Grant?		**No**	**Yes**	**Did not answer**	**Total**
	N	15	35	---	40
	%	37,5	62,5	---	100
What is the counter-delivery of Bombinhas		**No**	**Yes**	**Did not answer**	**Total**
	N	37	2	1	40
	%	92,5	5	2,5	100

QUESTIONS		BOMBINHAS			
Does the Grant represent an environmental risk?		**No**	**Yes**	**Did not answer**	**Total**
	N	35	4	1	40
	%	87,5	10	2,5	100
Were you aware of the		**No**	**Yes**	**Did not answer**	**Total**

Grant?	**N**	16	23	1	40
	%	40	57,5	2,5	100
What is the counter-delivery of Bombinhas		**No**	**Yes**	**Did not answer**	**Total**
	N	30	9	1	40
	%	75	22,5	2,5	100
Do you have treated water from Águas de Bombinhas?		**No**	**Yes**	**Did not answer**	**Total**
	N	---	40	---	40
	%	---	100	---	100
Do you think the price is fair?		**No**	**Yes**	**Did not answer**	**Total**
	N	15	24	1	40
	%	37,5	60	2,5	100
Is the lack of water recurrent?		**No**	**Yes**	**Did not answer**	**Total**
	N	15	21	4	40
	%	37,5	52,5	10	100

QUESTIONS		**ANSWERS GIVEN BY THE AUTHORITIES OF THE MUNICIPALITIES OF BOMBINHAS/SC**			
Does the Grant represent an environmental risk?		**No**	**Yes**	**Did not answer**	**Total**
	N	8	---	2	10
	%	80	---	20	100

QUESTIONS		**ANSWERS GIVEN BY THE AUTHORITIES OF THE MUNICIPALITIES OF TIJUCAS/SC**			
Does the Grant represent an environmental risk?		**No**	**Yes**	**Did not answer**	**Total**
	N	6	2	2	10
	%	60	20	20	100

Source: Questionnaire applied. Note: Prepared by the Authors.

3.2 Environmental Sustainability at the Water Catchment Site

The water catchment in the Tijucas River is located at Estrada Geral Porto da Itinga, s/nº, Bairro Itinga, Municipality of Tijucas, ZIP Code 88.200-000, comprised by the following UTM coordinates 727590.95 m E 6981520.00 m S, Zone 22J, Datum SIRGAS 2000 (Secretaria de Estado de Desenvolvimento Econômico e Social - SDE, 2017).

The consumptive flow rate required by Água de Bombinhas, according to a technical demand survey, submitted to the SDE, along with Proceedings No. 670/2017, is 210 L/s. But the maximum flow rate granted by the Secretariat was 250 L/s (SDE, 2017).

To meet the demand of water supply in the Municipality of Bombinhas, during the low season period of the year 2018, 39.1 L/s were needed, while in the high season of the same year, the demand was 98.2 L/s. However, it is estimated that for the year 2023, during the low season period 44.9 L/s will be required, concerning the high season period of the year in reference, the Municipality will have a demand de 113,9 L/s (Águas de Bombinhas, 2017).

If only half of the volume granted is considered, it is already enough to meet the entire resident and floating population of the municipality until the year 2049.

The capture regime was proposed of 24 hours, during all days of the month, with a maximum daily capture of 18,144.00 m3/day, being sufficient to meet the needs of the applicant (SDE, 2017). However, the State Department of Sustainable Economic Development granted the maximum daily volume captured at 21,600.00 m3 and monthly limited to 648,000.00 m3 (SDE, 2017).

According to art. 13 of Law 9433/97, the grants in basins under the domain of the Union are conditioned to the priorities defined in the Water Resources Plans for each basin, and the class in which the body of water is classified must be respected. It is important to mention the main reference water levels defined at the national level: Q7.10, the minimum water level of 7 days duration with 10 years of recurrence; Q90 and Q95, water levels whose probabilities of exceedance are 90% and 95%, respectively, defined by estimating the permanence curve of natural water levels (Almeida and Curi, 2016). Thus, each state of the federation, according to the guidelines of each managing body, has the autonomy to set the limits and reference flows, regarding the Grant, varying between the states.

Regarding the States, each one has its way of regulating the matter. If we analyze the legislation in

Spain, we can see that there is no division of competence - Union, States, and Municipalities, as in Brazil, but rather than water is a single competence, belonging to the State Administration (Luz and Gomes, 2011).

Regarding the Grant, Spain is much more comprehensive compared to Brazil, the definition of the limit of water use is the responsibility of the Hydrographic Confederations (equivalent to Hydrographic Basins), which have the consultative, participatory, decision-making, and planning power (Luz and Gomes, 2011; Briz, 2018).

If Santa Catarina is analyzed according to the technical criteria for catchment, the SDS Ordinance No. 36 of July 29, 2008, establishes that the waters of the state domain, for analysis of water availability, will be used as a reference flow rate, the Q98 - flow rate of permanence for 98% of the time (SDE, 2017).

Each state of the federation, according to the guidelines of the managing body, has the autonomy to define the limits and the reference flow rates, regarding the granting of concessions, varying among the states. Ceará, Paraíba and Sergipe have established that the authorizable limit is the annual Reference of 90% (Q90%), which can be captured daily and uninterruptedly. Bahia, on the other hand, adopts the same quotient, but the capture reference is daily and not annual (Stinghen and Mannich, 2019).

As for the states that make up the southern region of the country, when analyzing the maximum allowable flow rate, it appears that the Rio Grande do Sul gives autonomy to each watershed to set up and manage its plan, but while it does not exist, the flow rate will be 90% - Q90 (Governo do Estado do Rio Grande do Sul, 2014), with no maximum percentage defined, as there is in Santa Catarina. In Paraná, in turn, the adopted reference flow rate is the permanence 95% of the time (Q95%), limited to 50% of the reference flow rate (Stinghen and Mannich, 2019).

At the point of water catchment, the Q98 is 18.70 m3/s, according to state legislation that for Granting purposes, the maximum flow (equivalent to 50% of Q98), is 9.35 m3/s or 9,350.00 L/s.

About the environmental sustainability of the Tijucas River, it is observed that the authorization granted by the SDE was for the maximum capture of 250 L/s and the water body has an outflow of 9,350.00 L/s. Thus, the allocation represents only 2.67% of the capacity, meaning that it will not compromise the volume of water in the river (SDE, 2014).

The community of Tijucas when asked if the Water Use Grant represented some environmental risk, informed that they are confident that it will not affect the environmental sustainability of the Tijucas River, despite their confidence, of the residents living in Tijucas, 37.5% informed that they were unaware of the Grant and 62.5% were aware of it. While among the residents of Bombinhas, 40.0% did not know, 57.5% knew and 2.5% chose not to answer (Table 01).

Despite the relatively high percentage of those who did not know about Grant between the municipalities, about 90% of the interviewees have lived for more than 10 years in Tijucas and Bombinhas 95% (Tabela 01).

Among the municipal authorities in Tijucas, 60% believe there is no risk, 20% that there is and 20% did not answer. While 80% in Bombinhas affirm that there is no risk and 20% chose not to answer (Table 01).

As the Grant authorized the capture of only 2.67% of what is allowed, it is believed that the environmental sustainability of the Tijucas River was observed, with the amount being incapable of producing negative environmental effects in the Tijucas River Valley. Since the reference value preserves the flow of water, supplying the needs of Bombinhas since the authorized catchment of 250 L/s was authorized, with the expiration of the Grant in 30/06/2027.

3.3 Legal Possibility of Transaction

In Brazil, the supply of drinking water is a municipal competence, but privatization is the trend (Ramos, 2005; Díaz and Nunes, 2020; Gonçalves, 2017), because the Federal Law n. 14.026 of 07/15/2020, that updated the legal framework of basic sanitation, has the scope of delegating this service to the private sector (Brasil, 2020), for a period of 20 to 30 years (Vargas and Lima, 2004; Gonçalves, 2017).

This trend encounters many reservations since the water trade is focused on profit and not on the satisfaction of citizens (Tovar, 2003; Gonçalves, 2017). Thus, the combination of water scarcity and power (Barlow and Clarke, 2003) can cause much environmental damage, since the conception that the private sector can offer efficiency is illusory.

Analyzing the legal instrument and all corresponding legislation, we can see the legitimacy of Águas de Bombinhas in requesting the Grant for the use of water (registration ID # 96859), being its responsibility to capture from the Tijucas River spring (27º16'14" S and 48º41'50" W).

The capture point is located on Estrada Geral do Porto da Itinga (Bairro Itinga), left bank, with the type of capture in gravity derivation channel and the Environmental License authorized the implementation of a 500mm diameter cast iron pipeline in a total length of 27.4 km,

from the point of Estrada Geral Itinga to Rua José Ponciano da Silva, at the Water Treatment Plant - WTP (Previous Environmental License No. 4822/2017) (Fig. 02). The catchment point meets the guidelines for land use, as well as respects the forest and environmental legislation in force (Municipal Viability Certificate number 054/2017).

Fig.2: Water intake from Tijucas River to the Zimbros Water Treatment Plant.

Source: Figure elaborated by the authors.

It is extremely relevant to analyze not only the location, but the environmental management that seeks to control, reduce or avoid the impacts caused by the enterprise (Donnaire and Oliveira, 1995; Silva and Costa, 2016).

The environmental agency responsible at the time was the Environment Foundation - FATMA and, according to the Preliminary Environmental License (under No. 4822/2017), authorized the construction of the enterprise of capture, adduction and treatment of water for public supply.

The Grant and environmental licensing, when analyzed in an articulated manner, contribute to the efficient management of Water Resources, environmental preservation based on the mechanisms of control and command (Lanna, 1994; Silva and Costa, 2016). These instruments help in the establishment of sustainability indicators, based on a technical and careful assessment of the territory's carrying capacity (Silva and Costa, 2016; Genz *et al*., 2019).

The recognition of the limitation of Water Resources imposes the need to evaluate environmental impacts (Campos *et al.*, 2002; Chacon-Pereira *et al*., 2018), being fundamental to the effective engagement of society in decision making.

In Brazil, the management of Water Resources is organized by hydrographic basins, either in water bodies owned by the Union or the States (Porto and Porto, 2008; Silva and Costa, 2016; Silva and Teixeira, 2018). Concerning the Grant for water use, the Watershed Committees play a key role in the development of technical studies and opinions, regarding the applications (Pereira, 2016).

Given this importance, the applicant sent a letter (on May 31, 2017), requesting support from the Tijucas River Hydrographic Basin Committee (SDE, 2017). Despite the request for collaboration, within the process itself, no institutional response was issued, remaining silent regarding the appeal. The absence of response is a relevant fact.

In other studies, such as the allocation of water for the Cubatão River, SC, a lack of interest from the members of the Committee was also observed, related to the discontinuity of the work, lack of transference of financial resources, added to the lack of definition of the State System of Hydric Resources Management itself, being hypotheses that attribute a performance that does not meet the expectations of the hydrographic basin (Ramos, 2005).

Águas de Bombinhas, in the act of applying for the Grant, showed that the amount of water was enough to meet the resident population of the city, but that in the summer months the demand increased by up to 220%, causing collapse of the system (SDE, 2017).

The economy of Bombinhas is centred on tourism, due to the 4th best beach in the country (Águas de Bombinhas, 2017). Thus, according to the stated need and when analyzing the process as a whole, the notorious collaboration and encouragement that the Municipality of Tijucas provided to the interests of the applicant should be mentioned. As observed, in order to conduct the raw water captured to the water treatment plant, located in Bairro Zimbros, there would be the need for the implementation of approximately 27km of canalization, passing through the municipalities of Tijucas and Porto Belo. The passage through the first was authorized using administrative easement, through Municipal Law No. 2695, December 7, 2017.

The total deployment on public roads in Tijucas totals 1,330m in length. The remaining passage, 7,570m refer to private property areas (Tijucas, 2020). All areas were declared of public utility, for expropriation purposes, through Municipal Decree No. 1312/2018.

By consulting the bibliographical references, it was found several real cases of Granting and concession of water from local rivers, but none of them, had magnitude as the present one, being verified the Public Policy of

cooperation between the municipal entities of Tijucas and Porto Belo, to meet the water needs of Bombinhas, referring to the extensive easement granted by the former.

As consideration for the authorization of the use of the administrative right of way of Tijucas, in addition to the recuperation of the roads to their previous state, there were the charges for the implementation of the base for paving with graded gravel (E=20cm) and a 5cm layer of hot mix bituminous concrete in an area of 4,980m2, in addition to the execution of work with the same characteristics in an area of 23,520m2, on Avenida Emília Ramos, Bairro Universitário (Tijucas, 2020).

The population of Bombinhas, when asked if they were aware of the consideration that the municipality should provide, 75% said they were not aware of the obligations, 2.5% did not answer, and 22.5% said they were aware. Regarding the latter, they were asked if they were in favour, 30% said no, 2.5% chose not to answer, and 67.5% said yes (Table 01). The people who said they were against the transaction were asked the reason, and the most recurrent answers were: in the municipality, there is a water source; the lack of water has not improved. As for those who were in favour, they were also asked about the reasons and the most recurrent answers were: improved water shortage; improvements in the water treatment system.

On the other hand, the population of Tijucas, when asked if they were aware of the consideration that the municipality of Bombinhas should pay for the rights-of-way, 92.5% said they were unaware of the obligations, 2.5% did not answer, and 5% said they were aware. Despite the knowledge or not of the obligations assumed by the municipalities, they were asked whether or not they were in favour of the implementation of the water catchment system, 40% said yes, 10% chose not to answer, and 50% said no (Table 01). The most recurrent answers were: because the municipality lacks water; because of the lack of community involvement in the transaction. As for those who were in favour, the most frequent responses were: water is not only for the municipality of Tijucas; duty of solidarity.

Once the acts in the Executive and Legislative sphere are understood, the Public Policy of Cooperation between the Municipalities of Bombinhas and Tijucas is observed, in which both are subjects of rights and duties, and that the purpose of the pact signed was to provide the Municipality of Bombinhas, conditions in the public water supply for the resident and floating population.

Based on all the procedures cited, on June 30, 2017, Ordinance No. 166 was issued by the Deputy Secretary, which authorized the Grant for the Use of Water Resources, granting a maximum capture flow rate of 250L/s, with a daily captured volume of 21,600.00m3 and a monthly volume of 648,000.00m3, valid for a period of 10 years (SDE, 2017).

Bombinhas' water supply system was completed in 2018 and will start operating according to the population's water needs only in 2019. The work is a milestone for the municipality, as well as for the entire state of Santa Catarina.

The efficiency of the Zimbros Water Treatment Plant is a positive aspect, since in Brazil the loss of treated water is approximately 38% (Trata Brasil, 2017; G1, 2017), in Bombinhas it is around 15% (Portal Saneamento Básico, 2020).

The implementation of Bombinhas' new water system showed a higher utilization than the previous one since in July/2017 the water loss was between 35% and 30% in high and low season, respectively (Águas de Bombinhas, 2017).

Of the people living in the municipality of Bombinhas interviewed, 100% said they had treated water in their residence from Águas de Bombinhas. When asked about the price of the tariff practiced by the company, 60% said it is fair, while 37.5% think it is not and 2.5% did not answer; (Table 01), when asked the reason: most do not trust the water treatment system, others think the water quality is bad. For the authorities of Bombinhas, the price charged is fair, compared to the amount invested in the new water treatment system.

Regarding the lack of water, 52.5% (Table 01), state that it is still recurrent, especially in high season, although the system has been operating since 2019, but, it has not yet been properly tested due to the Covid19 pandemic. When tourism returns to its usual characteristics, the development can be fully evaluated. In the meantime, the data on water demand versus the water captured, indicate that the volume is sufficient to supply the resident and floating population of the municipality.

IV. CONCLUSION

In Brazil, there is a high number of Granting Authorizations granted by ANA, however, the State of Santa Catarina is responsible for only 0.36% of the total, for capturing waters under the jurisdiction of the Union. About the grants issued by the SDE, from 1997 to 2020, the number was 3,447, of which 2.05% originated from water captured from the Tijucas River. The case under analysis becomes unique because there was a public policy of cooperation between municipalities, signed by Bombinhas, Porto Belo and Tijucas.

The authorization for the abstraction of raw water from the Tijucas River represents 2.67% of the authorized flow, with a maximum daily capture of 18,144.00 m3, which is sufficient to supply the needs of the applicant. With the capture site, according to the environmental agency at the time (Fundação do Meio Ambiente - FATMA) and the Municipality of Tijucas, the installation works carried out at the collection point met all the environmental guidelines.

In this sense, it can be seen that both the water abstraction permit and the necessary works for the installation of the referred work did not represent a risk to the Tijucas River, being guided under the guidelines of environmental sustainability, in the condition of supplying the present need, without affecting the interest/right of future generations.

Despite this, the omission of the Tijucas River Hydrographic Basin Committee, within the granting process that went through the SDE, is something relevant, and that could not be overlooked, because, although the risks are low, a grant of this magnitude, which may serve as a model, should at least have the Committee's interest in the administrative process, in order to make some technical points to be observed by the applicant and the State Secretariat.

Regarding the Granting Process, it is pointed out that it was carried out within the strict legality, observing the precepts and guidelines established by the legislation in force, serving the present cooperation between the municipal entities, as a model to the other entities of the federation, as well as the Public Policy to supply the hydric shortage faced by several Brazilian regions.

Despite the large undertaking, Águas de Bombinhas, due to the pandemic (COVID-19), was not able to put the system into operation at full power. According to studies carried out by the company, the amount of water authorized for capture by the SDE (250L/s) is sufficient for the hydric supply of the city, during low or high seasons, until 2049.

Finally, considering the whole procedure of the Grant in reference, it can be seen that it meets what is defined in the Sustainable Development Goal 06 - Water and Sanitation, which seeks to solve the problem of water shortage, providing the resident and floating population of Bombinhas access to treated water, observing the principles of environmental sustainability.

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Physical-chemical and microbiological evaluation of mine waters in the Municipality of Caratinga - MG

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Abstract *— Water coming from mines to be destined for human consumption must comply with Ordinance No. 888 of May 4, 2021 of the Ministry of Health. the standard of potability of water for human consumption. The objective of this study was to evaluate, through physical-chemical and microbiological variables, the quality of mine waters that are being exposed to consumption by the population of the municipality of Caratinga-MG, using the parameters referred to by Ordinance No. 888 of 2021. The methodologies used for the analysis of physicochemical and microbiological parameters followed the protocols of the Standard Methods For the Examination of Water and Wastewater, 23rd edition. The results of the physical-chemical analyzes of all water collection points are within the potability standards required by Ordinance No. 888 of 202, and the results found referring to microbiological analyzes demonstrated that there is no contamination by fecal coliforms, and that It is an excellent index, and makes us think about applying the simple chlorination process, which can contribute to the disinfection process and maintain water quality. Consuming quality water is a right of every citizen, therefore, actions to adapt mine waters used by the population for consumption, or any other sources, are essential, and therefore, it is recommended to continue monitoring water quality of the mines studied in the municipality of Caratinga-MG.*

I. INTRODUCTION

The water mine is formed when the aquifer, that is, the subterranean sheet reaches the surface and, thus, the water stored underground surfaces on the surface of the land, and is popularly known as spring, mine, water hole, headboard, spout or fountain.

Water from mines to be destined for human consumption must comply with Ordinance No. 888 of 2021 of the Ministry of Health. This ordinance describes all the physical-chemical and microbiological parameters necessary for the standard of potability and human consumption, being o except applied only in mineral water source, natural or water added with salts intended for consumption after bottling, which are subject to the microbiological guidelines of Resolution (RDC) No. 274 of 2005 (BRASIL, 2005).

The characteristics found in groundwater are due to physical, chemical and biological processes that determine a wide variety of substances present in the water, and can also be affected by anthropogenic activities, such as domestic and industrial polluting loads, which can also influence the quality of water underground.

Normally groundwater is less prone to contamination, because, during the path in which water percolates between the pores of the subsoil and rocks, it is purified through a series of physicochemical and bacteriological processes, which naturally modify the characteristics of the water, making it more suitable for

consumption human (SILVA and ARAÚJO, 2003; PEIXOTO et al., 2017, PEIXOTO, 2020).

The use of groundwater can be advantageous when it is free from contaminants, however, Costa et al., (2012) reports that this water resource can have the potential for transmitting diseases caused by pathogenic microorganisms, which may come from feces of humans and animals, or through chemical substances in concentrations outside the standards allowed by Ordinance No. 888 of 2021, therefore, it is essential to verify and monitor their potability for human consumption.

Assuming that groundwater may somehow have the potential for contamination by microorganisms and at the same time for spreading disease (Costa et al., 2012, Peixoto et al., 2017, Peixoto, 2020), the need is reinforced to verify the physical-chemical and microbiological standards of groundwater, and the service for consumption in accordance with Ordinance No. 888 of 2021.

The aim of this study was to evaluate, through physical-chemical and microbiological variables, the quality of water from mines that are exposed to consumption by the population of the municipality of Caratinga-MG, and thus verify whether these water mines are used for human supply, reach the standards of Ordinance No. 888 of 2021 and are free of contaminants or if they need any type of treatment.

It is also reinforced that the municipality of Caratinga has an average infant mortality rate of 21.03 for every 1,000 children born alive, representing the position 171 out of 853 of the municipalities in the State of Minas Gerais (IBGE, 2017). And that many hospitalizations due to diarrhea are possibly linked to the consumption of water that is not properly treated.

II. MATERIALS AND METHODS

2.1. Studyareaand sample collection

This work was carried out in the municipality of Caratinga, which is located in the interior of the State of Minas Gerais, in the Vale do Rio Doce. According to the latest edition of the IBGE of 2010, the city has a population of 85.239 inhabitants, with an estimated 91.503 inhabitants in 2018 (IBGE, 2020).

The city's water and sewage treatment is the responsibility of the State Joint Company, Minas Gerais Sanitation Company (COPASA), headquartered in Belo Horizonte. The city's water supply system has a production capacity of 207.9 liters of water per second. The water reaches their properties along 167,114 meters of distribution networks (COPASA, 2018).

The water supply service provided to the municipality of Caratinga has a service percentage of 89.87% of the population and a coverage rate of 100% (ARSAE, 2016).

Collections were carried out in three water mines in the municipality, which are commonly used for supply and human consumption. These mines have the following geographic coordinates: -19.7909907, -42.1364616.1025, in the Santa Zita district; -19.785404, -42.1484615.512 (called collection point 1), mine located in the Anápolis district, at Street José Alves Pereira, and - 19.717815, -42.128485 (called collection point 2), mine located at BR 116, at (called collection point 3).

At collection point 1, there is a tap installed to facilitate the collection of part of the mine's water by people. At point 2, in the Anápolis neighborhood, the residents made a kind of pipe with a pipe to supply and consume water from this mine. And finally, at collection point 3, at Km 520, BR 116, there is a pipe with water that runs constantly in a faucet, both placed by residents for the mine's consumption.

2.2. Collection and processing of mine water samples

Collections were carried out in the three mines in triplicate and the transport of samples was carried out in accordance with the guidelines of the Standard Methods 23rd edition and the National Guide for the Collection and Preservation of Samples (ANA, 2011).

For the realization of the physical-chemical parameters, the collections were made in plastic containers with a capacity of 250 mL sterile. And for the analysis of microbiological samples, sterilized glass containers were used, with a capacity of 125 mL, sterilized at 180 ºC for 1:30 h. The collected samples were placed in a Styrofoam box with ice for transport and taken to the COPASA - Caratinga laboratory, where they were refrigerated at approximately 6 ºC until the analysis was carried out. Chlorine and temperature analyzes were performed in loco.

2.3. Physicochemical analysis of mine water samples

The physical-chemical analyzes performed were: pH, turbidity, chlorine, color, fluorine and conductivity, defined in accordance with Ordinance No. 888 of 2021. The temperature measurement of the samples was performed with a digital thermometer.

The methodologies for analyzing the physicochemical parameters were carried out in accordance with the Standard Methods For the Examination of Water and Wastewater, 23rd edition (APHA, AWA, WEF, 2017). The pH analysis is performed by the electrometric method by a digital device known as potentiometric, which measures the activities of hydrogen ions present in water.

And later the turbidity analysis used the nephelometric method, in a digital device that measures the deviation of light when passing through any particle in the water. And for color analysis, the photocolorimetric method was applied, in a digital device, which measures the wavelength of color absorption.

Chlorine analyzes were performed using the DPD colorimetric method, in which the device measures the wavelength in the absorption of colors caused by the DPD reagent in the presence of chlorine in water. Fitting the fluoride (or fluoride ion) analyzes performed by the selective ion electrode reading by electrode method, in which after adding a solution called TISAB, where the various ions present in the water complex with one of its constituents, leaving the ions of free fluorine to be measured. And finally, the conductivity analyzes performed by an electrometric method using an electrode sensitive to all ions present in water (APHA, AWA, WEF, 2017).

2.4. Criteria for carrying out microbiological analysis of water

For microbiological analyses, the presence/absence control for total coliforms and *Escherichia coli* (*E. coli*) was performed, using qualitative methodology, and also the measurement performed by the most probable number (MPN) of coliforms in 100 ml of sample, by quantitative methodology.

For the analysis of total coliforms and *E. coli*, the chromogenic substrate was used, which can be accounted for the presence of total coliforms in 24 hours in the oven at 35º C, which have a yellowish color, which after being placed in a dark room with a lamp ultraviolet, if the samples are fluorescent, they will be considered positive for *E.coli*, all methodology followed the Standard Methods For the Examination of Water and Wastewater, 23rd edition (APHA, AWA, WEF, 2017).

2.5. Suggested alternative for simplified treatment for mines in the municipality of Caratinga-MG.

As a suggestion for the proposal for treatment in the mines of this study, an alternative for installing simple chlorinators was presented, citing a project developed by the Brazilian Agricultural Research Corporation (Embrapa), which is linked to the one linked to the Ministry of Agriculture, Livestock and Supply (EMBRAPA , 2021).

III. RESULTS AND DISCUSSION

3.1. Physicochemic alanalysis

The temperature measurements of the samples were carried out in loco, and presented values ranging from 19°C to 21°C, which are considered within the normal range for groundwater and without interfering with water quality (FAVARIN, 2017).

The results regarding the pH (hydrogenionic potential) are within the potability standards and within the recommended range of 5.5 to 8.0, which corroborate the work carried out by CERQUEIRA, (2014).

The pH is defined as the negative logarithm of the concentrations of hydrogen ions, ranging from 0 to 14. Values less than 7 (seven) acidity, and the lower, the more acidic. Values from 7 to 14 indicate increased alkalinity, and the more alkaline the closer it is to 14 FRITZSONS et al., (2009). According to FEITOSA et al., (2008), the pH of groundwater can generally vary between 5, 5 and 8.5, in agreement with the results found in this work.

Table 1 - Results of the physicochemical analyzes of water from the mine in point 1.

Collection point 1	pH	Chlorine (mg/L)	Fluoride (mg/L)	Turbidity (NTU)	Color (uH)	Conductivity (µS/cm)
Collection 1	7.7	0	0.17	0.37	5.9	256
Collection 2	7.7	0	0.16	0.28	2.7	256.1
Collection 3	7.7	0	0.13	0.38	6.0	256.3

Source: Authors (2021).

With respect to fluoride ions, these presented values below expectations, ranging from 0.13 mg/L to 0.17 mg/L, as can be seen in table 1. The fluoride content in groundwater, values that can vary between <1 to 25 mg/L, depending on the geological and physicochemical factors of the area where the water mine is located (NETTO, et al., 2016).

According to the Ordinance 888 of 2021, the fluoride ion in drinking water needs to be less than 1.5 mg/L, which is in accordance with the results found in this work, presented in table 1. It is noteworthy that the absence of this chemical compound does not characterize a water as non-potable , but the controlled addition of this ion is one of the most important caries prevention measures. Some

groundwater has this compound naturally (BRASIL, 2009b).

The turbidity results, presented in the samples are below 1.0 NTU 3, as shown in table 1. A turbidity is a parameter of great importance in physicochemical and bacteriological controls and the Ordinance No. 888 of 2021defines that in at least 95% of the analyzed samples the turbidity needs to be up to 1.0 NTU (turbidity unit).

The WHO international standards of water for human consumption recommend maximum levels of up to 5 NU of turbidity, if this parameter appears higher than this value, there may be material suspended in the water, and these contribute by fixing the pathogens, making the action difficult of simple treatments, such as the use of chlorine over them for water disinfection (SCHWARTZ et al., 2000).

Regarding the parameter of colors observed in the samples in table 1, they are below 15 uH, the values found are in accordance with what was determined by the Ordinance No. 888 of 2021 (BRASIL, 2021).

Also in table 1, the conductivity values result in TDS lower than 1,000mg/L, corroborating the values already found by FEITOSA et al., (2008), and also in relation to the chlorine compound, it was observed that it was not found in the samples from this location, however, the Ordinance No. 888 of 2021, establishes a minimum of 0.2 mg/L and a maximum of 5.0 mg/L, for water that is treated and used for human consumption.

Finally, regarding the values related to electrical conductivity, it is important that it is between 50 to 1500 µS/cm in drinking water. The quantification of the conductivity parameter is important due to the excess of dissolved particles in the water be harmful to health (SANTIAGO et al., 2007; FEITOSA et al., 2008). It can also be observed in table 1, that in the water samples from this point 1, this parameter was kept within the allowed values, ranging from 256 (µS/cm) to 256.3 (µS/cm).

In the analyzes performed at collection point 2, the pH results are all within potability standards and within the recommended range of 5.5 to 8.5 (CERQUEIRA, 2014) for groundwater, as shown in table 2. table, it can be noted that the chlorine had the expected content, since it is water without prior chlorination (BRASIL, 2016a)

Fluoride ions had values equal to 0.08 mg/L, as shown in table 2. This content is expected for groundwater without fluoridation. According to Ordinance 888 of 2021, the fluoride ion must be below 1.5 mg/L. The fluoride content in groundwater can vary between <1 to 25 mg/L, depending on the geological and physicochemical factors of the area where the water mine is located (NETTO, et al., 2016).

And with regard to the turbidity results, these also showed values below 1.0 NTU, which is recommended by Ordinance 888 of 2021 and the same occurred with the color patterns found, as can be seen in table 2 (BRASIL, 2017).

The conductivity values found result in TDS lower than 1,000mg/L, corroborating FEITOSA et al., (2008) and presented values equal to 244.4 (µS/cm).

Table 2 - Results of the physical-chemical analyzes of water from the mine in point 2.

Collection point 2	**pH**	**Chlorine(mg/L)**	**Fluoride (mg/L)**	**turbidity (NTU)**	**Color (uH)**	**Conductivity(µS/cm)**
Collection 1	5.9	0	0.08	0.20	3.1	244.4
Collection 2	5.8	0	0.08	0.14	3.5	244.4
Collection 3	5.9	0	0.08	0.12	<2.5	244.4

Source: Authors (2021).

In the physicochemical analyzes carried out in point 3, the pH results were between 5.2 and 5.3, these values being slightly below the recommended range, which is 5.5 to 8.5 for groundwater (CERQUEIRA, 2014), as can be seen in table 3. It was also observed in table 3 that the samples did not contain chlorine, as expected, as it is not treated water (BRASIL, 2016).

And with respect to fluoride ions, presented in table 3, the values were equal to 0.08 mg/L, content is expected for groundwater without fluoridation. The turbidity results are below 1.0 NTU, with values equal to 0.30 NTU and 0.34 NTU, as recommended by Ordinance No. 888 of 2021. The colors have values below 15 uH, being in accordance with the determined by the Ordinance (BRASIL, 2021). The conductivity values found result in TDS lower than 1,000mg/L, which is in agreement with the work carried out by FEITOSA et al., (2008) (Table 3).

Table 3 - Results of the physicochemical analyzes of water from the point 3 mine.

Collection point 3	pH	Chlorine (mg/L)	Fluoride (mg/L)	Turbidity (NTU)	Color (uH)	Conductivity (µS/cm)
Collection 1	5.2	0	0.08	0.33	<2.5	74.8
Collection 2	5.3	0	0.08	0.34	3.1	74.9
Collection 3	5.2	0	0.08	0.30	<2.5	77.4

Source: Authors (2021).

3.2. Microbiological analysis

All microbiological analyzes of point 1, referenced in table 4, showed presence for total coliforms, and absence for E.coli. Total coliforms are mostly not pathogenic, but they can pose health risks, as well as deteriorate water quality, causing unpleasant odors and tastes, while *E. coli* bacteria are part of this group and their origin is essentially fecal (FUNASA, 2013). The probability of finding pathogenic bacteria in water is greater the greater the number of coliforms in this water (DEMAE, 2001)

Table 4 - Results of microbiological analyzes at collection point 1.

Collection point 1	Total coliforms	Total coliforms (NMP)	*E. coli*	*E. coli* (NMP)
Collection 1	Presence	1989,3	Absence	0
Collection 2	Presence	866.4	Absence	0
Collection 3	Presence	866.4	Absence	0

Source: Authors (2021).

The microbiological analyzes of point 2, represented in table 5, showed presence for total coliforms, and absence of for *E. coli*. Total coliforms are used as evidence of contamination and the *E. coli* species is considered the best indicator of fecal contamination, and can be found in sources other than feces (FUNASA, 2013), the fact that it is not found in the samples in this study , is already a good sign of water quality.

Table 5 - Results of microbiological analyzes at collection point 2.

Collection point 2	Total coliforms	Total coliforms (NMP)	*E. coli*	*E. coli* (NMP)
Collection 1	Presence	14.6	Absence	0
Collection 2	Presence	19.5	Absence	0
Collection 3	Presence	24.9	Absence	0

Source: Authors (2021).

Only collection 2 from this point 3 showed 1 NMP of bacteria from the total coliform group, the others absent for total coliforms and *E. coli*.

According to Ordinance No. 888 of 2021, water for human consumption must present absence of fecal coliforms. All water samples are adequate in this regard, and in accordance with this ordinance.

Table 6 - Results of microbiological analyzes at collection point 3.

Collection point 3	Total coliforms	Total coliforms (NMP)	*E. coli*	*E. coli* (NMP)
Collection 1	Absence	0	Absence	0
Collection 2	Presence	1	Absence	0
Collection 3	Absence	0	Absence	0

Source: Authors (2021).

The group of coliforms are classified into total coliforms and thermotolerant coliforms and are considered indicators of contamination most used to monitor the sanitary quality of water (SCURACCHIO, 2010). The presence of total coliforms in water is not necessarily indicative of fecal contamination or occurrence of enteropathogens, it may be related to the presence of *E.coli* (BORELI et al., 2014).

3.3. Suggested installation of a tablet chlorinator for water treatment in Mines in the municipality of Caratinga-MG.

According to Ordinance No. 888 of 2021, for the use of any water for human ingestion, it is necessary to undergo at least a simplified treatment such as disinfection; this is because, only with the disinfection process (the most common chlorine) will water be safer for human consumption.

Some even resist the presence of chlorine in treated water and often assimilate its characteristic smell and taste as something undesirable, or even toxic SILVA & VALENTINI (2020) and LUCAS & BOHNE (2015).

The disinfection of water can be carried out by different physical or chemical processes, and even a combination of them is possible. Historically, the most used oxidizing agent in water treatment processes has been chlorine, in the form of gaseous chlorine (Cl_2), sodium hypochlorite (NaOCl) and calcium hypochlorite ($Ca(OCl)_2$). Its disinfectant power is high, easily acquired on the market, and its antibacterial action is mainly due to its atomic structure with a tendency to gain electrons, and high oxidizing power. Thus, chlorine can penetrate the cell wall of microorganisms that are predominantly negatively charged, and inhibit the oxidation of glucose, which is vital for bacterial growth (BRASIL, 2006), thus leaving the water free of microorganisms.

Thinking about water supply and consumption in small communities without access to water treated by sanitation companies, it was developed in 1978, in a partnership between COPASA and the Minas Gerais State Education Department, the tablet chlorinator, which aims to improve the potability of water distributed in several schools in the state education system in the metropolitan region of Belo Horizonte, however, it should be noted that there are several models of tablet chlorinators, but basically their operating mechanism is the same. The tablets usually have the composition of calcium hypochlorite, which gradually releases the chlorine ions into the water needed for water disinfection (BRASIL, 2006).

The average duration of the tablets must be defined through the residual chlorine control, which needs to be between 0.2 to 5.0 mg/L. For this it is essential that this content is analyzed frequently. Currently, there are laboratory equipment on the market for chlorine analysis of various models, as well as visual and digital methodologies (SOARES et al, 2016).

The tablet chlorinator model developed by Embrapa (Brazilian Agricultural Research Corporation), shown in Figure 1, is simple to make and inexpensive, in addition to having an easy-to-understand booklet, which is freely accessible on the company's website. It follows the model chlorinator of inserts assembled by EMBRAPA (2014; 2021).

Fig.1: Chlorinator suggestion model for communities without access to treated water.

Source: Embrapa (2014).

As the water mines in this work are small flows, the consumption of pellets will probably be small, and you will be able to apply this model in each of the points where water is collected for human consumption. It is noteworthy that in the booklet, there are also instructions on how to perform the chlorine content analysis using a visual methodology with the "measuring kit" that are easily found in stores specializing in swimming pool treatment.

The suggestion made in this work, with the application of a simple chlorinator system, aims to keep the water consumed by the local population in perfect potability. The installation of chlorination processes can be elaborated by the local residents or by the public authorities, being still necessary the control and monitoring of these waters, to guarantee its potability.

IV. CONCLUSION

The physicochemical analyzes found at all collection points are within the potability standards required by Ordinance No. 888 of 2021. And with regard to microbiological analyzes, these showed that there is no contamination in the samples by fecal coliforms, and this is an excellent index , and that makes us think that a simple chlorination system that can be applied at the points of collection and human consumption, and it aims to contribute so that the water from these mines will guarantee the quality within the desired standards.

Water quality is perennial, its controls and care must be frequent, as well as maintenance of cleanliness and asepsis of sources, pipes and connections. This work assumes, with the analyzes carried out, that the water being chlorinated will be suitable for consumption and will be able to meet the parameters recommended by Ordinance No. 888 of 2021.

Consuming quality water is a right of every citizen, therefore, actions to adapt or improve quality are always a way of trying to guarantee the desired standard of human consumption so that they do not have problems with the ingestion of disease-causing pathogens. And it would be of interest in these localities to study the continuity of water quality monitoring, for a greater guarantee of water consumption within the recommended standards.

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Development and Performance Analyses of Thermal Energy Storage System using Shea Butter as Phase Change Material

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***Keywords*— Thermal Energy Storage System, phase change material, heat transfer fluid.**

***Abstract*—** *The focus of this study is to experimentally determine the performance of latent heat thermal energy storage using shea butter as a phase change material (PCM) in a heat exchanger (shell and tube). This involved determination of the thermo-physical properties of the PCM, design of a suitable heat exchanger (shell and tube) to serve as the storage system where the shell (mild steel) will contain the PCM in direct contact with the tube (copper), construction of the system based on the designed parameters and performance evaluation of the system through experiments (water used as heat transfer fluid), energy and exergy analyses. DSC analysis reveals a transition temperature in the range 31.26^{0}C to 40.16^{0}C and latent heat of 50.36kJ/kg. These values are low compared to other commonly used PCMs such as paraffin wax (100^{0}C, 140kJ/kg), stearic acid (55.8^{0}C, 160kJ/kg) and Acetamide (82^{0}C, 263kJ/kg). The system is designed to heat water from 25^{0}C to 35^{0}C, however the maximum temperature achieved is 31^{0}C. Melting and solidification curves shows non uniform melting and solidification of the PCM during charging and discharging operations. The overall performance of the system based on energy and exergy analyses revealed satisfactory performance with minimum energy efficiency of 59.04% and maximum of 89.88% and minimum exergy efficiency of 20.37% and 30.44% maximum.*

I. INTRODUCTION

Thermal Energy extracted from solar thermal energy systems or energy recovery systems such as waste/excess heat from industrial heat processes are often more than demanded and are therefore allowed to waste. This is because like solar energy, waste heat demand and supply tends to be in mismatch. In order to meet with the out of phase demands for the aforementioned systems and their likes, there is need for supplementary or recovery system(s). One of the available options is to develop energy storage devices, which are as important as developing new sources of energy. Energy storage not only reduces the mismatch between supply and demand but also improves the performance and reliability of energy systems and plays an important role in increasing the efficiency of energy utilization. . Thermal energy can be stored in three different forms namely sensible heat storage, latent heat storage and thermochemical heat storage.

The use of a thermal storage system using phase change materials (PCMs) is one of the most effective ways of storing thermal energy and has the advantages of high-energy storage density (amount of energy stored in a given system or region of space per unit volume). Phase

transformation occurs at relatively constant temperature hence the isothermal nature of the storage process is of great advantage, (Sharma and Sagara 2005). Phase change materials (PCMs) have been widely used in latent heat thermal storage systems for heat pumps, solar engineering, and spacecraft thermal control applications. There are large numbers of PCMs that melt and solidify at a wide range of temperatures, making them attractive in a number of applications.

Many researchers have worked on thermal energy storage systems for more than four decades using different kinds of phase change materials and system configurations for different applications. Thirugnanam and Marimuthu (2013) have investigated experimentally the feasibility of using PCM in heat recovery system, in their study;a double pipe type heat exchanger was designed and fabricated for low temperature heat recovery system using paraffin wax as PCM. Two mass flow rates of 15lph and 20lph were used in the experiment. It is observed that the heat stored in 20lph is higher than 15lph.So when flow rate is increased the heat storing as well as heat releasing capacity increased. Their result shows the feasibility of using PCM in heat recovery system. Furthermore, Jesumathy et al. (2014) evaluated the thermal behavior of 0.7 kg of commercial paraffin in a shell-and-tube heat exchanger, placed both horizontally and vertically, under the influence of different heat transfer fluid (HTF) (water) mass flow rates and inlet temperatures during the melting and solidification processes. Results showed no subcooling of the paraffin and demonstrated that the modification of the HTF operating conditions has a higher influence during melting than during solidification.

A numerical study was conducted by Zhinuo Zhou et al. (2015) to explore the effectiveness of $NH_4(SO_4)_2.12H_2O$ as a new inorganic phase change material used for solar thermal energy storage in residential building in cold climate. The heat transfer pattern was studied both experimentally and simulation. The charging heat efficiency was optimized when the heat source temperature was 26.5C higher than the phase transition temperature. This helps satisfy the storage demand and also the utilization of solar thermal energy.

El-Kaddadi and Asbik (2017) carried out experimental study of heat transfer during latent heat storage cycle (charging/discharging) in a vertical cylindrical system. The experimental setup consists of two cylindrical tanks filled respectively with hot and cold water, a test bench, and measurement instruments. They observed that the convective heat transfer coefficient between the heat transfer fluid (HTF) and the annular space is improved by increasing of the mass flow rate of the heat transfer fluid. Niu*et al.*, (2019) carried out experimental investigations on thermal storage performance of a shell and tube unit with a metal-foam composite heat exchanger (Mtube) with pure paraffin (smooth tube) as the basis of comparison. The complete heat storage time of the Mtube unit was found to be 63.6% shorter than the smooth tube unit at the same flow rates. By comparing the temperature distribution of the two heat storage units, flow rate is found to have little effect on metal-foam-tube unit and relatively strong influence on the smooth-tube unit. The result also shows that compared to the smooth tube unit, the M-tube unit due to the expanded heat transfer area have improved heat transfer coefficient and weakened natural convection hence the bottom PCM in the M-tube unit melts faster.

Bayomy*et al.*, (2019) developed a three dimensional numerical model of a water based thermal storage thank using phase change material. A computational fluid dynamics CFD numerical code was developed for a domestic hot water tank using PCM to the demand of a family of one, two, three and four. It was observed that for a given hot water supply, increasing the number of families increases the efficiency from 35% for family of one to 82% for four families. Also, increasing the hot water supply during the charging periods increased the storage efficiency from 35% to 39%. It was observed that increase in family demands improve the thermal efficiency of the storage system due to the increase in the portion of energy recovered during the night time.

In choosing a phase change material for thermal energy storage, the transition temperature and latent heat of fusion are the major properties considered. The transition temperature must correspond to the desired application temperature and the latent heat should be relatively large for a high storage density and to reduce the overall system size. Other properties such as thermal conductivity and specific heat capacity are also essential in the design of thermal storage system with phase change material.

This work aims at investigating the feasibility of using shea butter as phase change material for thermal energy storage. The latent heat of fusion and transition temperature were determined using differential scanning calometery and presented in figure 2.1 while other properties such as density, thermal conductivity and specific heat capacity were determined using appropriate laboratory equipments. The thermo-physical properties of the shea butter used are presented in table 2.1 below

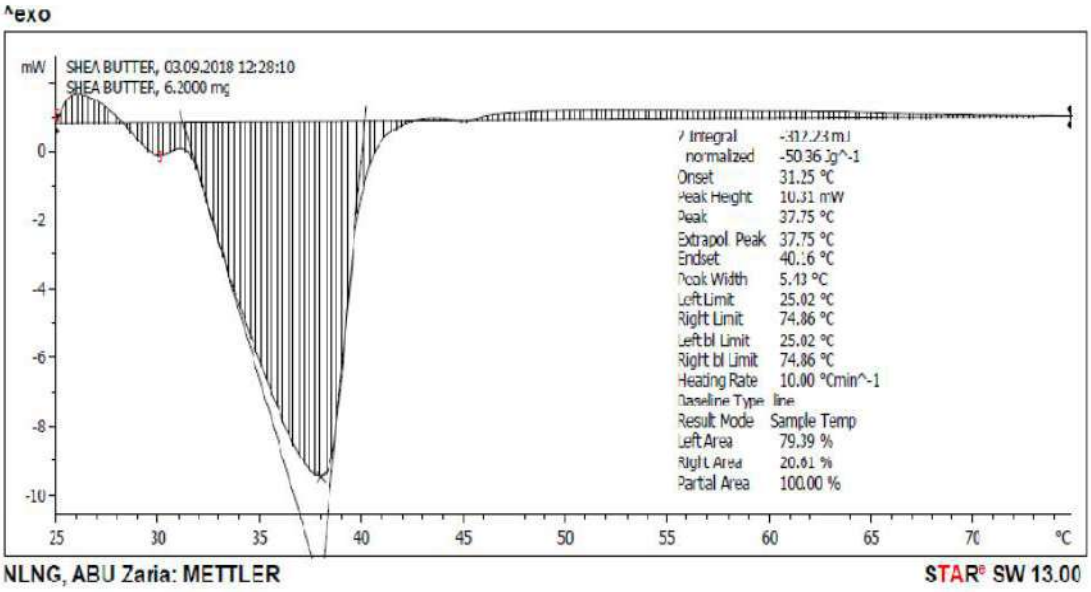

Fig.1.1: Result of Differential scanning calorimetery analysis of shea butter

Table 1.1: Thermo-physical properties of shea butter

Transition temperature	31.26 – 40.16 ^{0}C
Latent heat of fusion	50.36 kJ/kg
Density (liquid phase)	880 kg/m^3
Density (solid phase)	910 kg/m^3
Specific heat capacity (solid phase)	3.19 kJ/kg^{0}C
Specific heat capacity (liquid phase)	3.32 kJ/kg^{0}C
Thermal conductivity	0.26 W/m^{0}K

II. METHODOLOGY

The experimental setup consists of two 50 liters plastic containers for hot and cold water supply which is the heat transfer fluid for charging and discharging processes. An electric heater of power rating of 1500W with thermostat for generating hot water at controlled temperature. Each of the containers have a control valve for adjusting the flow rate of the heat transfer fluid and are connected to a digital flow meter using a T-joint. The digital flow meter has a temperature sensor that indicates the temperature of the fluid passing through it. A total of four thermocouples, three within the thermal energy storage system and one at the outlet of the TES are connected to a multipoint digital thermocouple meter to record the outlet temperature and the axial temperature distribution within the phase change material over a time interval. The technical specification of the heat exchanger, schematic diagram and the experimental setup are shown in table 2.1 and figures 2.1 and 2.2 respectively.

Table 2.1: Technical specification of the thermal storage system

Part Name	Material	Size
PCM	Shea Butter	7kg
Inner pipe	Copper	10mm diameter, 5m length
No of coil	Copper	15
Coil diameter	Copper	104mm
Coil pitch	Copper	30mm
Outer pipe	Mild steel	152.4mm diameter, 0.45m length
Insulation	Fiber glass	5cm
External case	Aluminum	0.5mm

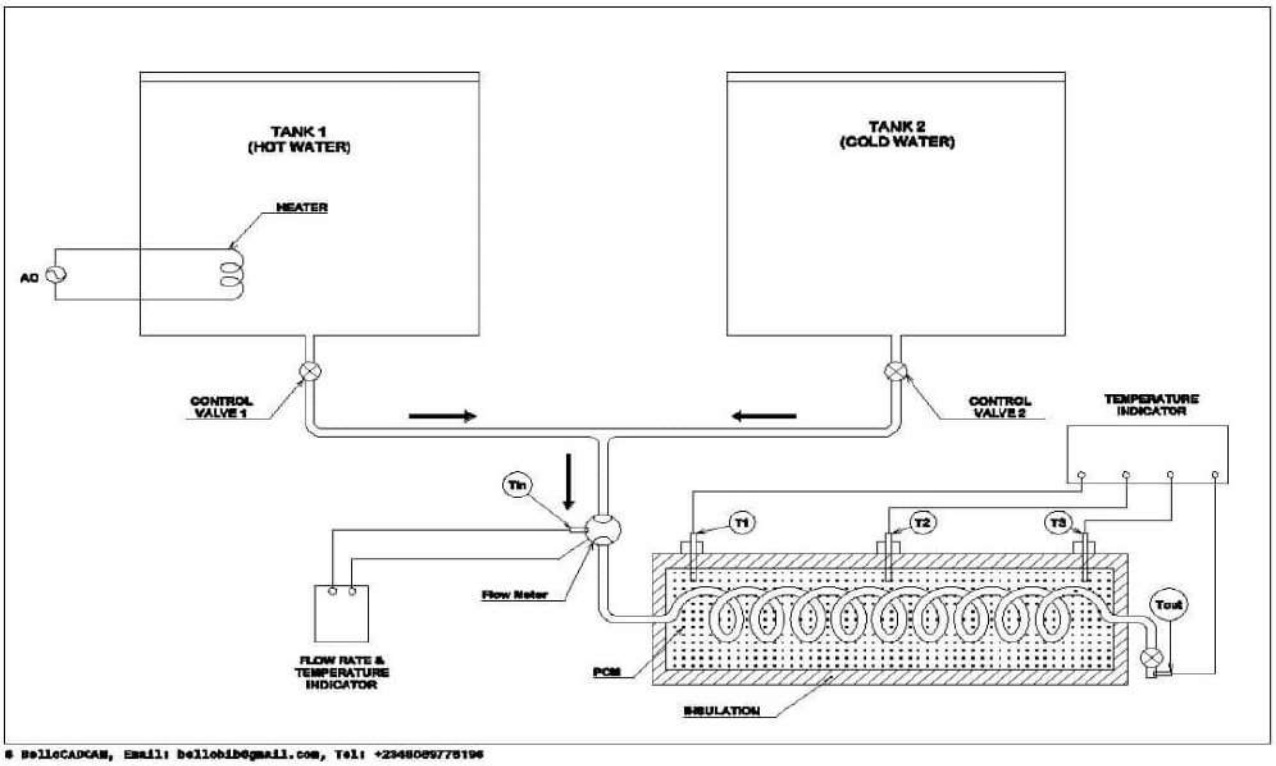

Fig.2.1: Schematic Diagram of the Experimental Setup

Fig.2.2: Experimental setup

III. RESULTS AND DISCUSSION

3.1 Energy and Exergy Analyses

The performance of the developed thermal storage system is analyzed by experiment. Four experiments were conducted for different heat transfer fluid flow rates of 0.0145, 0.0180, 021, and 0.0245kg/s and hot water inlet temperature in the range 60^0C to 70^0C. The cold water inlet temperature during discharging process is the ambient temperature

For experiment 1

Rate of Energy storage is determined from the equation

$$rate\ of\ Energy\ in, \dot{Q} = \dot{m}c_f(T_{in} - T_{out}) = \dot{m}(h_{in} - h_{out})$$

Average Tin = 68^0C

Average Tout = 64^0C

$$h_{in} = h_f\ at\ 68℃ = 284.6kJ$$

$$h_{out} = h_f\ at\ 64℃ = 267.82kJ$$

Flow rate = 0.89lpm = 0.00089m^3 /min

Mass flow rate of heat transfer fluid= volumetric flow rate × density

$$Density\ of\ HTF = {}^{1}/_{v_f}\ at\ 68℃$$

$$v_f\ at\ 68℃ = 0.10218 \times 10^{-2}\ {}^{m^3}/_{kg}$$

$$Density\ of\ HTF\ at\ 68℃ = 978.66\ {}^{kg}/_{m^3}$$

Mass flow rate $\dot{m} = 0.00089\ {}^{m^3}/_{min} \times 978.66\ {}^{kg}/_{m^3} \times \frac{1min}{60sec} = 0.0145\ {}^{kg}/_{s}$

$$rate\ of\ Energy\ in, \dot{Q} = m(h_{in} - h_{out}) = 0.0145 \times (284.6 - 267.82)$$

$$\dot{Q} = 0.2433\ kW$$

Energy stored over 44mins of charging

$$Q = \dot{Q} \times time = 0.2433 \times 44 \times 60 = 642.312\ kJ$$

$$Exergy\ stored = Energy\ stored * (1 - \frac{T_e}{T_{pcm}})$$

Te = ambient temperature = 25^0C = 298 K

T_{pcm}=52.67^0C

$$exergy\ stored = 642.312\left(1 - \frac{298}{325.67}\right) = 54.57kJ$$

For Discharging Process,

$$rate\ of\ Energy\ retreived, \dot{Q}_r = \dot{m}c_f(T_{0ut} - T_{in}) = \dot{m}(h_{out} - h_{in})$$

Average Tin = 29^0C

Average Tout = 30.30^0C

$$h_{in} = h_f\ at\ 29℃ = 121.5kJ$$

$$h_{out} = h_f\ at\ 64℃ = 126.945kJ$$

$$\dot{m} = 0.0145\ {}^{kg}/_{s}$$

$$\dot{Q}_r = 0.0145(126.947 - 121.5) = 0.079\ kW$$

Energy retrieved over 80 minutes of discharge

$$Q_r = 0.079 \times 80 \times 60 = 379.20\ kJ$$

$$Exergy\ released\ by\ the\ PCM = Q * (1 - \frac{T_e}{T_{pcm}})$$

$$Exergy\ released\ by\ PCM = 379.2\left(1 - \frac{298}{307}\right) = 11.117kJ$$

$$Energy\ efficiency, \eta = \frac{energy\ recovered\ from\ TES}{energy\ input\ to\ TES}$$

$$\eta = \frac{379.20}{642.312} = 0.5904 = 59.04\%$$

$$Exergy\ efficiency, \psi = \frac{Exergy\ recovered\ from\ TES}{Exergy\ input\ to\ TES}$$

$$\psi = \frac{11.117}{54.57} = 0.2037 = 20.37\%$$

In the same way the rate of energy storage, rate of energy retrieval, energy stored during charging, energy retrieved during discharge, exergy stored, exergy retrieved, energy efficiencies and exergy efficiencies for experiments 2,3 and 4 are determined and presented in table 3.1 below.

Table 3.1: Results of energy and exergy analysis for the four experiment

No.	Mass flow rate (kg/s)	Rate of charging (kW)	Rate of Discharge (kW)	Energy stored (kJ)	Energy retrieved (kJ)	Energy efficiency (%)	Exergy stored (kJ)	Exergy retrieved (kJ)	Exergy efficiency (%)
1	0.0145	0.243	0.061	642.312	379.2	59.04	54.57	11.117	20.37
2	0.0180	0.272	0.103	326.400	271.92	83.30	27.116	8.255	30.44
3	0.0245	0.589	0.264	706.800	635.27	89.88	59.376	17.27	28.08
4	0.0210	0.370	0.120	444.000	316.00	71.17	39.346	9.26	29.53

3.2 Melting/Solidification and Temperature Distributions

The melting/solidification of the PCM and temssperature readings at three points ($T_{1pcm,}$ $T_{2pcm\ and}$ T_{3pcm}) for the charging and discharging processes for the four experiments are depicted in figures 3.1a,b,c,d to 3.4a,b,c,d.

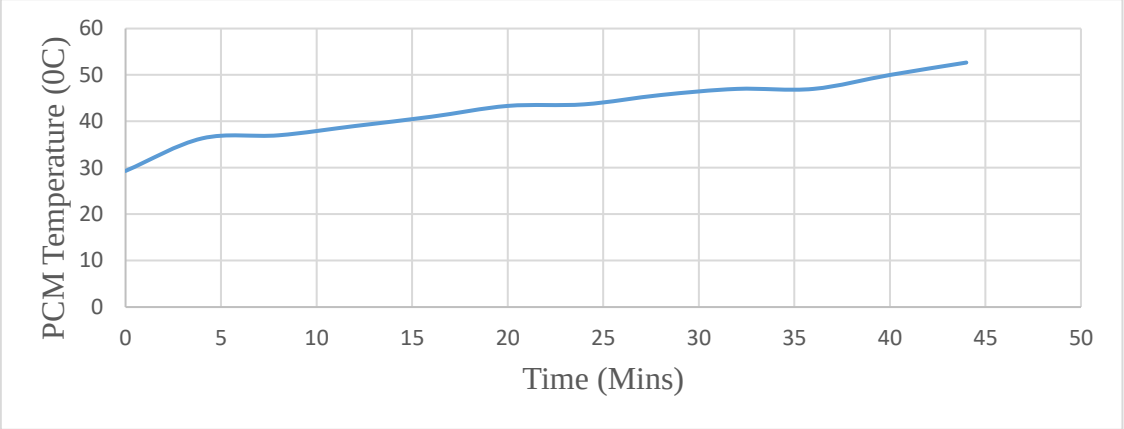

Fig.3.1a: Melting curve for charging process of experiment 1 (mass flow rate-0.0145, average Tin-68^{0}C, charging period-44min, energy strored-642.312kJ, exergy stored-297.39kJ)

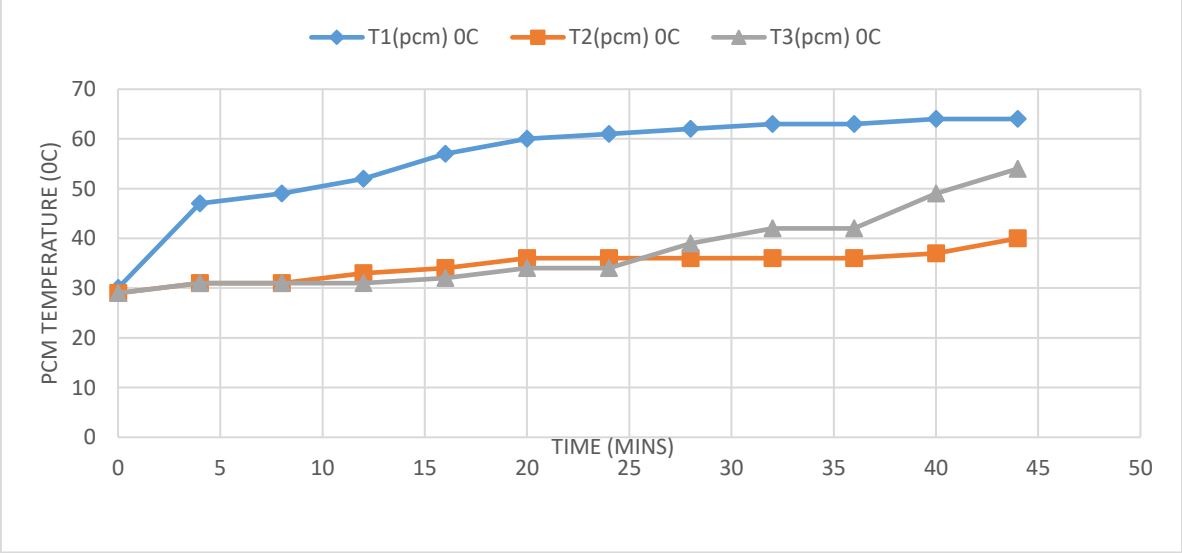

Fig.3.1b: Temperature distribution in the PCM during charging in experiment 1

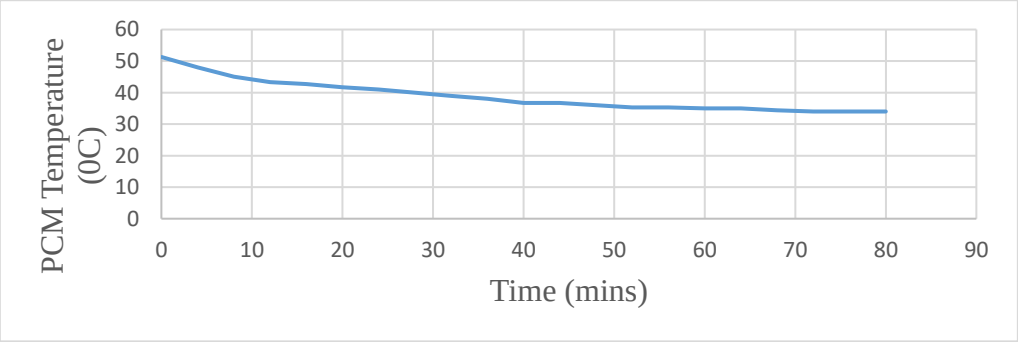

Fig.3.1c: Solidification curve for discharging process of experiment 1 (mass flow rate-0.0145kg/s, average Tin-29^{0}C, average Tout-30.30^{0}C, discharging period-80mins, energy retrieved-379.2kJ, exergy retrieved-55.78kJ)

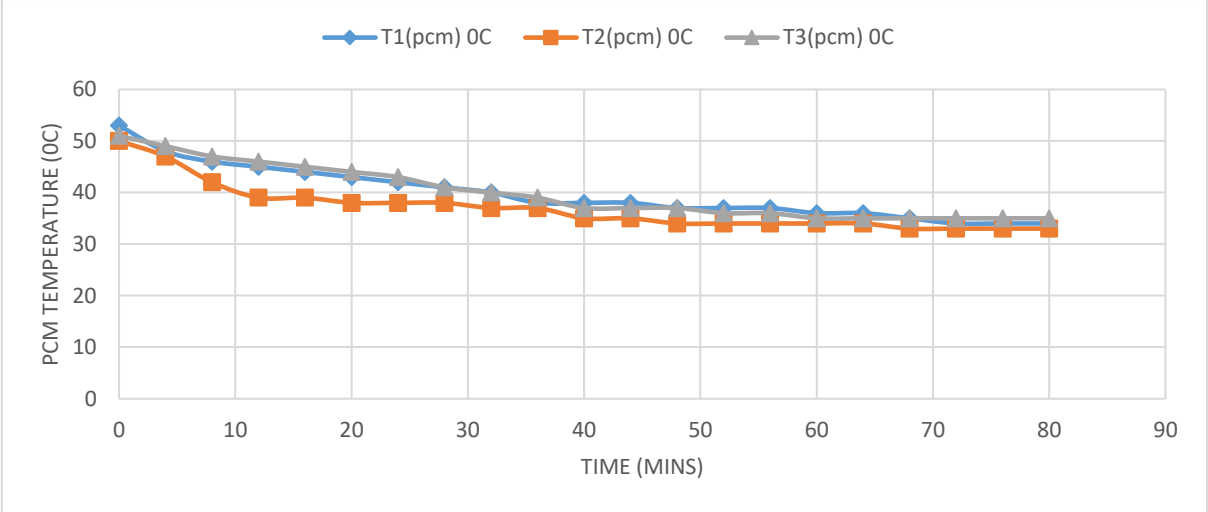

Fig.3.1d: Temperature distribution during discharge process for experiment 1

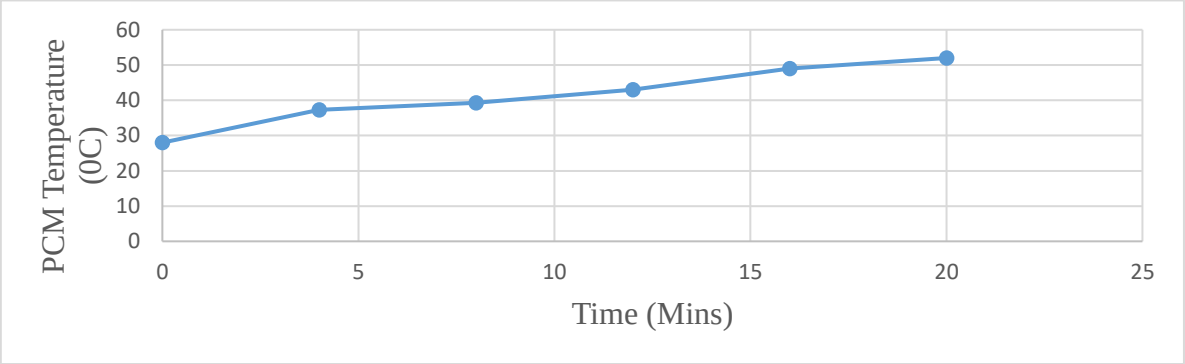

Fig.3.2a: melting curve for charging process of experiment 2 (mass flow rate-0.018kg/s, average Tin-69^{0}C, charging period-20mins, energy strored-326.4.312kJ, exergy stored-150.674kJ)

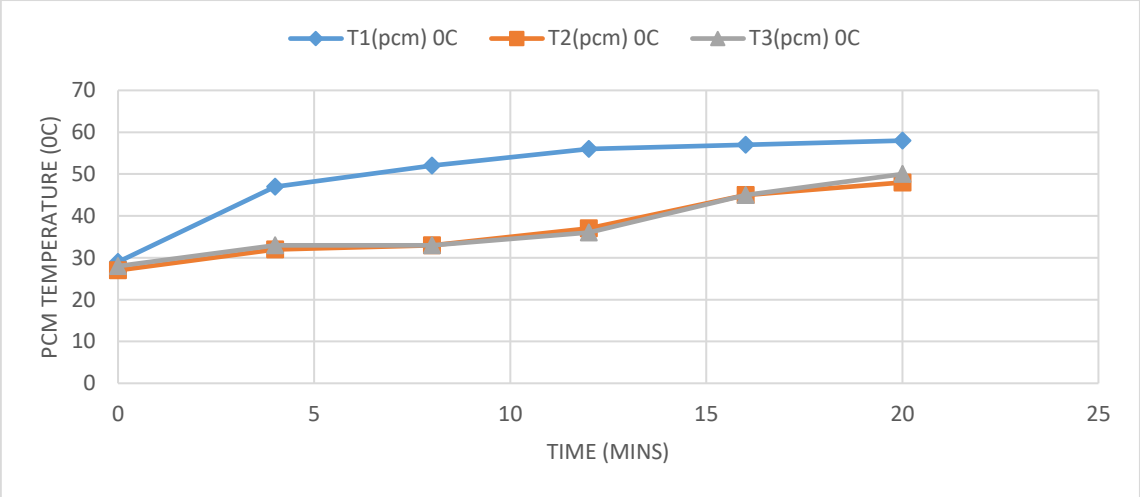

Fig.3.2b: Temperature distribution in the PCM during charge process for experiment 2

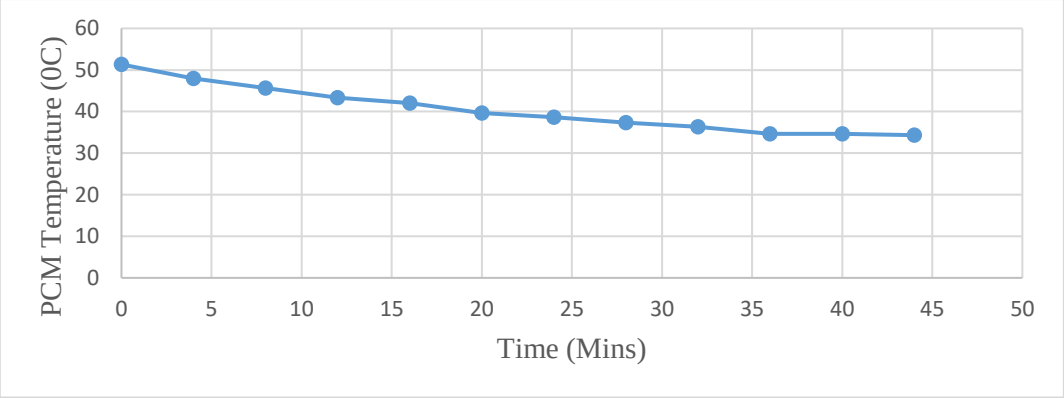

Fig.3.2c: Solidification curve for discharging process of experiment 2 (mass flow rate-0.018kg/s, average Tin-28^{0}C, average Tout-29.36^{0}C, discharging period-44mins, energy retrieved-271.92kJ, exergy retrieved-50.142kJ)

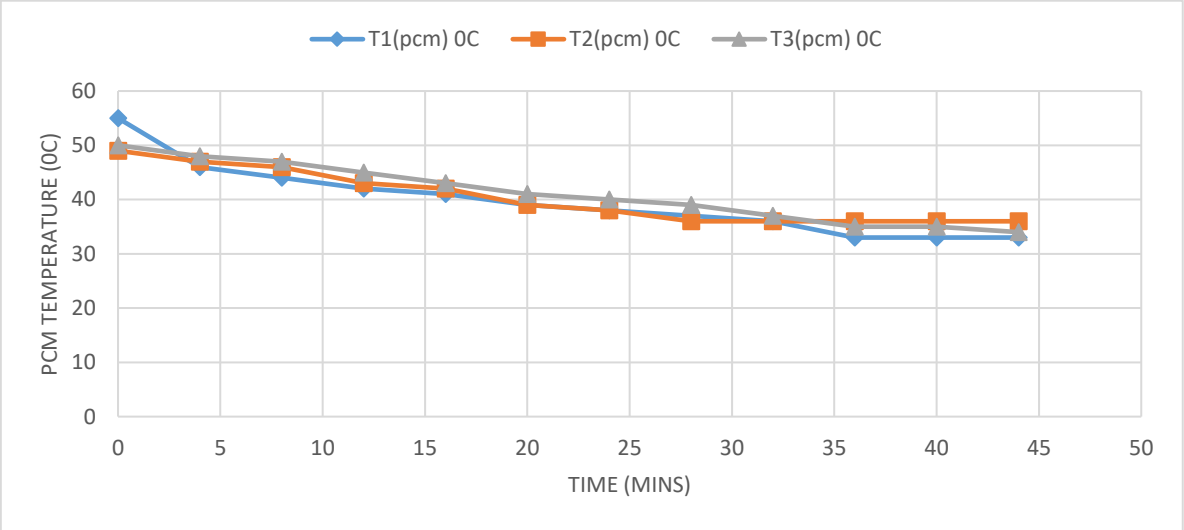

Fig.3.2d: Temperature distribution in the PCM during discharge process for experiment 2

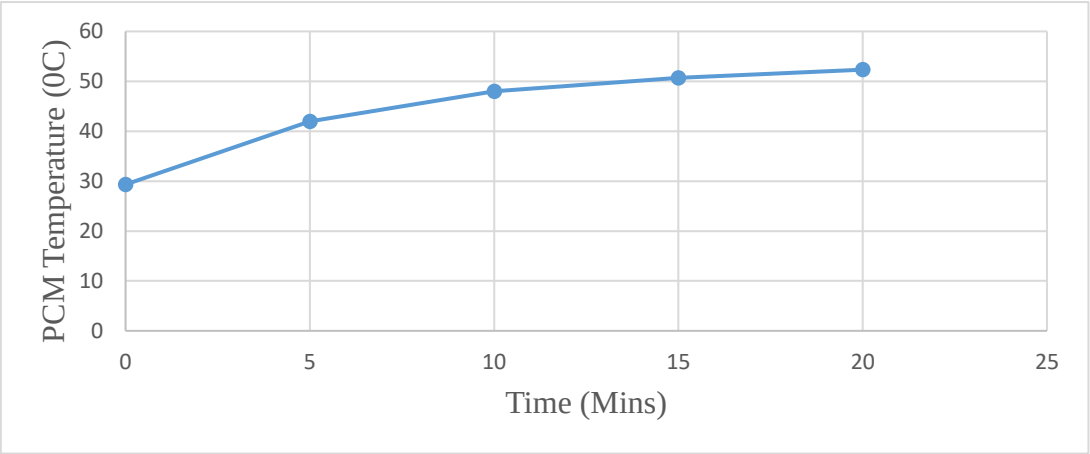

Fig.3.3a: Melting curve for charging process of experiment 3 (mass flow rate-0.0245kg/s, average Tin-66.25^{0}C, charging period-20mins, energy strored-706.8kJ, exergy stored-328.662kJ)

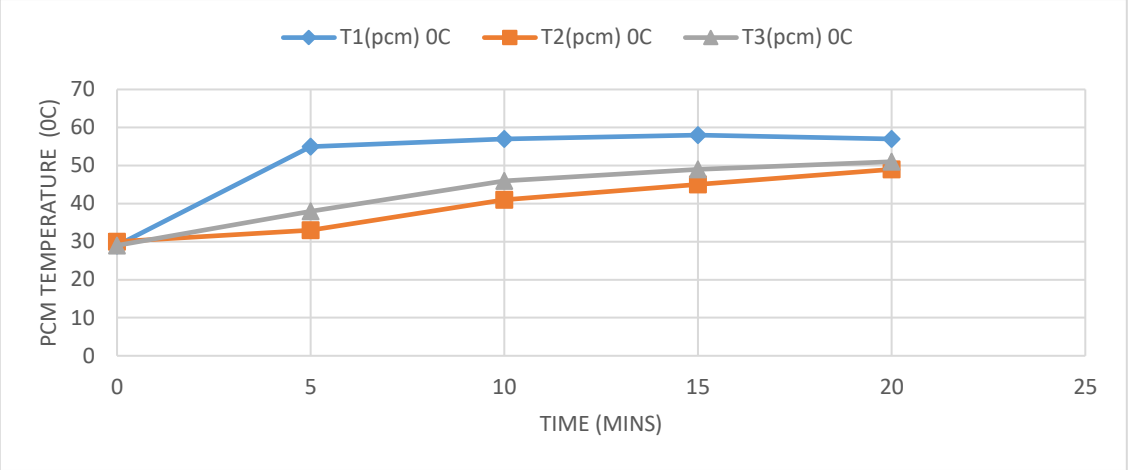

Fig.3.3b: Temperature distribution in the PCM during charging for experiment 3

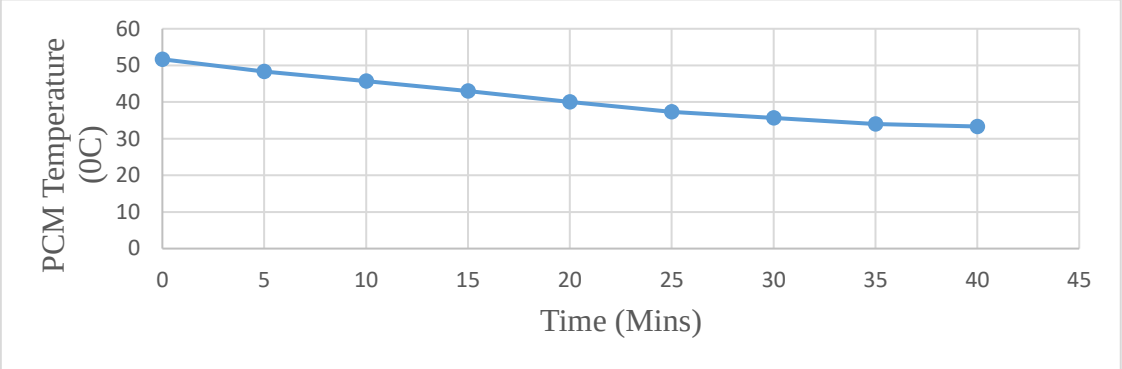

Fig.3.3c: Solidification curve for discharging process of experiment 3 (mass flow rate-0.0245kg/s, average Tin-28^{0}C, average Tout-29.62^{0}C, discharging period-40mins, energy retrieved-635.27kJ, exergy retrieved-101.643kJ)

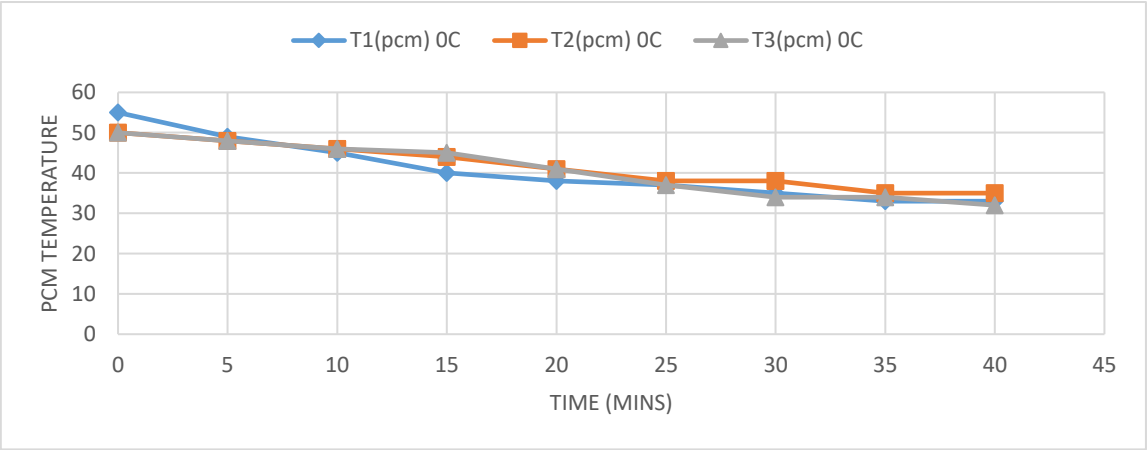

Fig.3.3d: Temperature variation in the PCM during discharge process for experiment 3

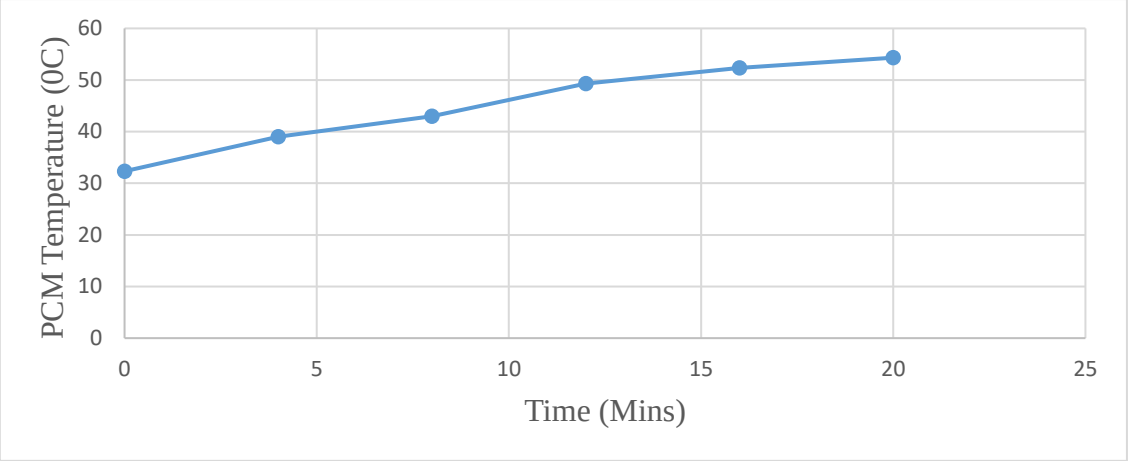

Fig.3.4a: Melting curve for charging process of experiment 4 (mass flow rate-0.021kg/s, average Tin-69^{0}C, charging period-20mins, energy strored-444kJ, exergy stored-215.176kJ)

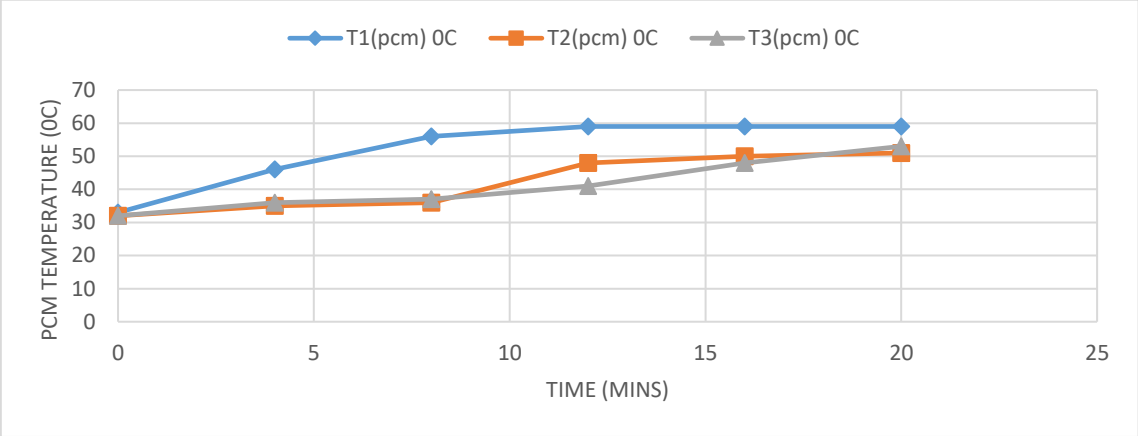

Fig.3.4b: Temperature distribution inthe PCM during charging process for experiment 4

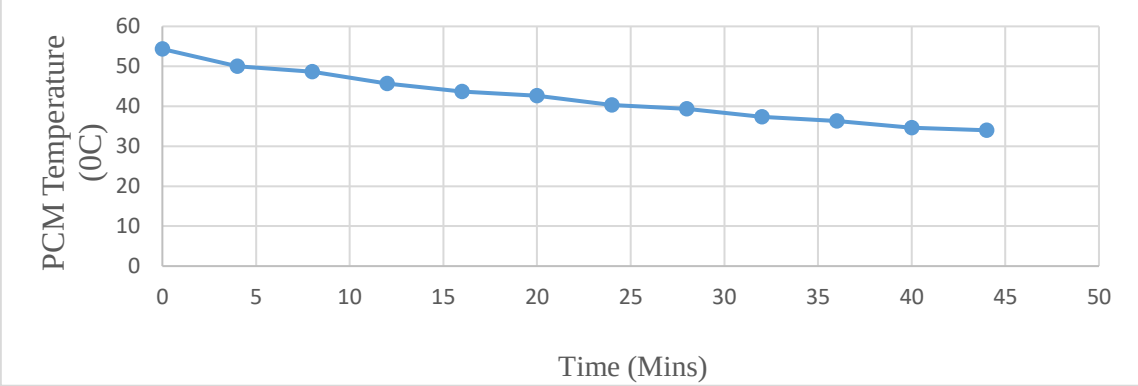

Fig.3.4c: Solidification curve for discharging process of experiment 4 (mass flow rate-0.021kg/s, average Tin-28^{0}C, average Tout-29.36^{0}C, discharging period-44mins, energy retrieved-316kJ, exergy retrieved-55.774kJ)

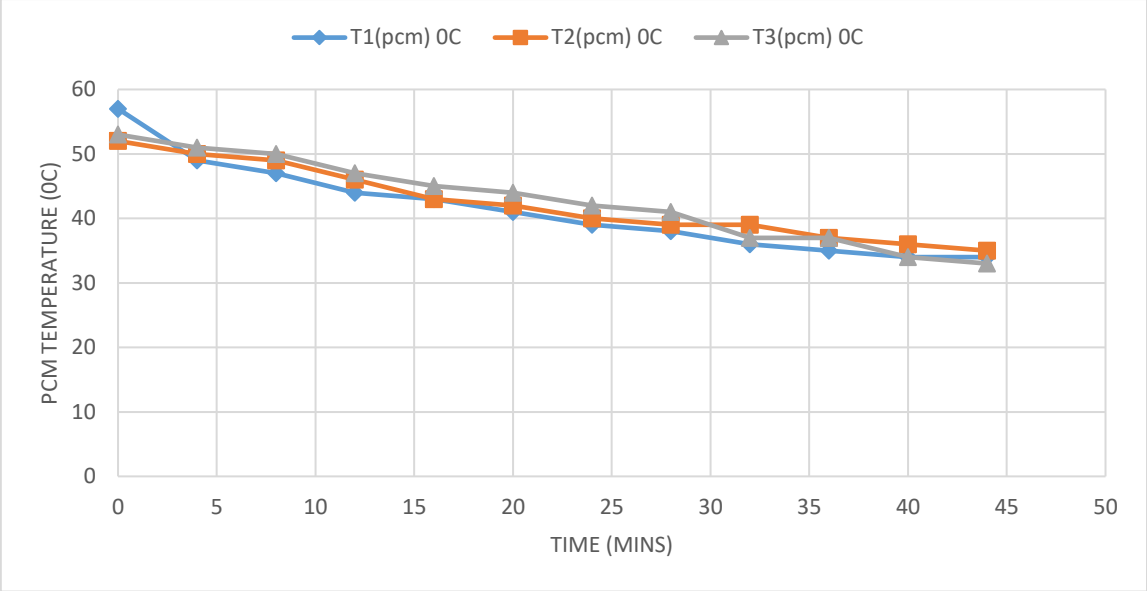

Fig.3.4d: Temperature distribution in the PCM during discharge for experiment 4

IV. DISCUSSION OF RESULTS

The performance of the developed thermal storage system is analyzed by experiment. Four experiments were conducted for different heat transfer fluid flow rates of 0.0145, 0.0180, 021, and 0.0245kg/s and hot water inlet temperature in the range 60^0C to 70^0C. The cold water inlet temperature during discharging process is the ambient temperature. The flow rates were measured using a digital flow meter with a thermocouple that reads the inlet temperature of the heat transfer fluid. Temperatures within the PCM and the outlet temperature were measured using a multipoint digital thermocouple meter.

The selected phase change material like most of phase change materials available for thermal energy storage suffers low thermal conductivity which results in high charging and discharging period and incomplete melting and solidification of the PCM during operations. Characterization of the shea butter reveals low thermal conductivity of 0.26 W/mK at 35^0C and Latent heat of fusion of 50.36kJ/kg. This value is low compared to paraffin wax which is one of the most commonly used PCM for low temperature applications. The low latent heat of this PCM will lead to low energy storage density and by implication a large in size energy storage unit with low energy to be stored.

The temperature readings from three points ($T_{1(pcm)}$, $T_{2(pcm)}$ and $T_{3(pcm)}$) within the PCM during charging and discharging were found to vary considerably as depicted in figures 3.1b, 3.1d, 3.2b, 3.2d, 3.3b, 3.3d, 3.4b and 3.4d. It was observed that the maximum temperature attained by the heat transfer fluid in discharge process of all the experiments is 31^0C and a maximum temperature increment (ΔT) of 3^0C (28^0C to 31^0C). This could be attributed to the low thermal conductivity of the PCM and non-uniform solidification of the PCM.

Generally, low thermal conductivity of phase change materials results to poor performance of thermal energy storage system and local concentration of heat which tends distorts the thermal properties of PCM and may also lead to system failure.

The energy stored, energy retrieved, exergy stored and exergy retrieved were computed using equations. Table 3.1 above give the summary of computed results. It could be observed that the heat transfer fluid flow rate has significant effect on the charging and discharging times. The energy stored is observed to increase with increase in HTF flow rate for the same charging time of 20 minutes for experiments 2, 3, and 4 except for experiment 1 which has high melting time of 44 minutes and relatively high energy stored. This variation might be attributed to the degree of melting of the PCM. This same behavior is observed for energy retrieved, exergy stored and exergy retrieved.

Energy and exergy efficiencies were also evaluated using equations and presented in table 4.5. Since exergy is a measure of the quality of energy, exergy efficiency is more significant than energy efficiency and should therefore be considered in the evaluation of thermal energy storage systems. Energy and Exergy efficiencies for experiments 1, 2, 3 and 4 were found to be 59.04, 83.83, 89.88, 71.17 and 18.76, 33.28, 30.92 and 25.92% respectively.

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Use of Playful Strategies: Sensitization of the Theme of Pressure Injury for Nursing Professionals

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***Keywords*—nursing education, ludotherapy, nursing professionals, pressure injury.**

Abstract*—*Objective: to report the experience of students who used playful activities in an educational action with professionals from the multidisciplinary team on the subject of pressure injury in a reference hospital in Belém do Pará. Method: this is a descriptive and qualitative study of the type of experience report, which aims to describe the experience of academics from an academic league of urgency and emergency in the metropolitan region of Belém. Results: the study reports the observation of playful activities for nursing professionals, which consists of a board game where the professionals of the given hospital had great adherence in the action and, in view of this, it was perceived that they had some doubts that were clarified during the game. Conclusion: playful instruments are facilitated forms of learning, and it was well received by the hospital nursing team that reported satisfaction with the action and how important it was to ensure quality care, besides being of paramount importance periodic updates on pressure injury for nursing professionals, because they are responsible for direct care to the patient, and during the action it was noticed by the academics that the playful strategies have a greater attractiveness and ensures a better learning..

I. INTRODUCTION

Considered one of the main adverse events observed in health services, pressure injury (PPL) is characterized as a damage that can arise in the skin and other underlying tissues intact or ruptured. Its incidence is closely related to areas of bony prominence or medical objects that exert a harmful pressure on the tissue. [1], [2], [3]

In this context, some factors corroborate the onset of PPL such as age older than 60 years, some chronic

diseases, prolonged mechanical ventilation, and insufficient decubitus change. [3], [4]

PPL develops in several regions of the human body. A longitudinal study conducted with 105 patients from a public hospital in the city of Rio de Janeiro showed that the area with the highest prevalence of injury is the sacral region, followed by the sciatic and calcaneus region. These data confirm the results of another study conducted in two public hospital institutions in the municipality of Campo Grande, where there was a frequency of 29.8% of injury in the sacral region. [1], [3]

According to each layer of the skin reached, a classification of PPL's is performed in stages ranging from 1 to 4. Thus, a stage 1 lesion presents a hyperemic intact skin, which does not whiten; in stage 2 there is a loss of the epidermis and a partial loss of the dermis; in stage 3 there is loss of the skin in its total thickness; and stage 4 can be characterized by skin loss in its total thickness and hair loss. [3]

PPL it can also be considered as non-classifiable when there is full-thickness skin loss and non-visible tissue loss, as well as when it presents persistent dark red, brown or purple discoloration, which does not whiten, being classified as a deep tissue lesion. [3], [4]

In this perspective, PPL is part of the sixth goal among the International Goals for Patient Safety, so in hospitals they perform various activities that contribute to the prevention of PPL based on scientific evidence that contribute to the quality of care, such as: change of decubitus; use of scales such as the Braden Scale; microclimatic control of the patient; daily inspection of customer's skin; among others. It is noteworthy that these are fundamental care for the prevention of PPL. [1], [4], [5]

In this scenario, nurses play an important role in the care of PPL, because nursing is a science whose main objective is care, acting both in prevention and health promotion. In this context, Resolution of the Federal Nursing Council Nº. 0567/2018 deals with the professional's performance in the face of this problem, giving power to analyze, determine and perform interventions in all categories of injuries in patients under their care.

In Intensive Care Units (ICU), PPLs are frequent in bedridden patients, requiring technoscientific preparation for the prevention and care of these lesions. In a study of the evaluation of the Risk Assessment Scale for the development of Pressure Injury in Intesives Care – EVARUCI – Souza, Zanei and Whitaker [6] report that it is essential to create bundles, such as the one published in the American Journal of Critical Care, which points out important strategies in the implementation of protocols, aiming to reduce the incidence of pressure injury in critical patients and reinforce the need for clinical judgment performed by the nurse.

The use of measures for Continuing Education (EC) and campaigns to raise awareness about PPLs for professionals are effective in recent studies, as is the case of the Vargas and Santos Study's [7], where they report that after evaluating the effectiveness of a campaign for the prevention of PPL in a Teaching Hospital, the results showed an increase in the percentage of accession, statistically significant for repositioning, lateralization angulation and headboard elevation and elevation of calcaneus. Highlighting better rates of support for the sector with the team most involved in the discussions during the training activities.

Based on international classifications of care such as the Classification of Nursing Interventions (NIC), the nursing team can perform actions such as: skin supervision; patient positioning; bed rest care; self-care assistance: bathing/hygiene; exercise therapy: ambulation; pressure control over areas of the body; injury care. [8]

The damage to the patient is significant with the development of PPL. It is essential to identify patients with risks to develop it early, and the use of the Braden scale enables the implementation of preventive measures by the entire multidisciplinary team, however, to implement these measures the precise team is able to develop quality care for these patients. [9]

Campoi1 report in their study that this problem directly interferes with the length of stay of patients in hospitals and is considered a public health problem. Working with the prevention and treatment of PPL generates benefits for both the patient and the institution. Texeira et al. [10] reports in their study that ICU patients have patients most affected by this complication, meaning a rate of 58.8% of their study, which corroborates with the direction of the hospital for a playful action, aiming at training and CS to update and exchange experiences among multidisciplinary professionals about the subject.

In this scenario, it's understood that the use of playful activities is a mechanism that helps in teaching, learning with the transmission of knowledge about a given subject, besides providing better learning for the fixation of information, enables greater interaction between the multidisciplinary team in the sharing of their knowledge and experiences. [11]

In this conception, the present study aims to report the experience of nursing students who performed playful activities in an educational action with professionals of the

multidisciplinary health team on the theme LPP in a reference hospital in Belém, state of the Pará.

II. METHODOLOGY

This is a descriptive and qualitative study of the experience report type, which seeks to describe the experience of academics from the interdisciplinary academic league of urgency and emergency in the metropolitan region of Belém.

The action was carried out in a large reference hospital in the city of Belém, in November 2019. Among the sectors visited are: surgical clinic, pediatric clinic, obstetric clinic, cardiac clinic and emergency, adult intensive care unit, emergency and psychiatric clinic.

The recreational activities lasted for three days, during the month of November, during the three shifts: morning, afternoon and night. According to this schedule, the members of the league, in a meeting, divided the members of the league to minister the recreational activities at the hospital. 15 people were chosen, 5 for each shift. All members of this action were students of nursing, physiotherapy, pharmacy and medicine courses, ranging from the 4th to the 10th semester of their respective courses.

The target audience of the action was all professionals from the multidisciplinary team of these sectors. During the period of the actions, 62 professionals from the hospital's multidisciplinary team participated, including 12 nurses, 39 nursing technicians, 6 physicians and 5 nutritionists.

The league's academics decided, through a prior meeting between the members, that the lecture would be playful and dynamic, as the use of playfulness facilitates learning, in addition to helping in the transmission of information acquired by professionals during the action. [12]

Thus, two dynamics were used. The first was a board game, using the following tools: 1 dice; 1 board with squares numbered 1 to 20; 10 questions on the particular LPP topic. The second dynamic consisted of a memory game, where there were photographs referring to the categories of injuries, and they formed a pair with the characteristics of each described injury. The two dynamics were presented in a meeting with the hospital's head of nursing, obtaining approval to be carried out a week later. The proposed objective was to provide professionals with a better understanding of the subject of LPP and its updates, in addition to providing a moment of interaction with the team in a simple and harmonious way.

The two dynamics came from the guidelines of the National Pressure Injury Advisory Panel. The questions were about: the definition of LPP; What are the phases; risk factors; intrinsic and extrinsic factors; what care should be taken; what types of covers can be used at each stage; how to prevent.

III. RESULTS AND DISCUSSIONS

The game consisted as follows: the participant played the data and later a question was asked about the proposed theme. With each hit, the participant advanced the number of squares on the board according to the result of the data. The game was finished when the participant reached the end of the board. Three random professionals from each sector were invited to participate in the game.

A great mastery of nursing professionals on the proposed theme was observed, and it was possible to observe this through the answers given during the game, generating debates and discussions on the subject. This debate encouraged professionals to talk a little about their main difficulties with PPLs. In the case of other professionals, the theme lacked mastery, which demonstrated a possible failure between the communication of the care of the multidisciplinary team regarding this problem.

Ludicity is of paramount importance not only because it works in a way that is not uncomfortable, but also, it is one of the strategies for working together: body, mind and spirit. Important parts for the union with the other, with the family and the company in general. The use of play provides for both parties dialogical actions that enable reflection, making them as transforming agents, in addition to significant learning on the theme discussed. [13], [14]

Morares et al. [15] says in their study that the prevention of PPL in Brazil was highlighted after the publication of Ordinance No. 529 of April 1, 2013 by the Ministry of Health, which establishes the National Patient Safety Program, where the 6th goal of risk reduction and drop of pressure injury is aimed at reducing to an acceptable minimum of the damage associated with the care of the by making a daily assessment of the risks that develop PPL; perform decubitus change every 3 hours, skin care such as hydration, guide and involve the family in the care process on measures to prevent PPL.

The first difficulty reported by them is the lack of adequate material for the performance of nursing care in PPL, and this would consequently imply an increase in the incidence of new PPL and/or worsening of a PPL. In addition, it was discussed that even with the difficulties reported, some basic care such as changes in decubitus,

stimulation of patient autonomy and nutrition care are essential for the prevention and treatment of PPL. Texeira et al. [10] reports that several studies bring the difficulty of professionals regarding work materials, such as age and other materials to promote improvement of injuries, being a difficulty of developing and underdeveloped countries. However, with knowledge, it is possible to mitigate various situations of daily hospital life.

PPL is a public health problem, besides being an adverse event in which nursing acts directly in care, besides being responsible for prescribing care and monitoring the client's recovery, as well as ensuring the quality of care. [16]

The nurse should assume the role of manager of activities in the work environment, for this, it is necessary that the professional develops his skills, both scientific and practical, which includes the use and indication of materials and equipment that are continuously renewed and modified, the risk assessment for the development of PPL and daily evaluation of the patients' skin, as an important item in the prevention of this disease, having the change of decubitus foundation of paramount importance in this scenario. [17], [18]

Another difficulty reported by the professionals referred to patients who already had some level of PPL when arriving in the sectors to receive care. This is directly related to the lack of materials, because even with all efforts, it was difficult to contain a PPL that already existed in the patient. Patients arriving from intensive care units were usually the ones with the most cases of PPL. Texeira*et al.*[10] reports that ICU patients are more conducive to developing LPPs, as they are patients who, in general, remain bedridden for longer, being an aggravating factor for this type of intercorrence.

In Cooper's analysis [19] patients hospitalized in the ICU, there is a high prevalence to develop LPPs, due to the presence of several devices such as intravenous catheters, sequential compression devices, in addition to the infusion of several vasoactive drugs that cause decreased sensory perception leading the patient not to have an excessive pressure reaction.

For Inoue and Matsuda [20], in addition to the potential harm caused in the patient, the LPP triggers a series of expenses of financial resources to the health organization, which can be avoided with the use of resources that prevent the emergence of PPL.

The application of Essential Fatty Acids (EGA) with the use of a comfort massage was a subject discussed through the students and the nursing team, because comfort massage can cause more injuries in a sensitive skin, and most professionals did this massage, accompanied by AGE. In this perspective, Busanello et al. [21] brings with it a current observation about PPL, where comfort massage is a contraindicated practice, because in the presence of acute inflammation, in patients with weakened skin tissues and impaired vascularization, massage is not recommended because it can cause a new lesion or worsen a hyperemic area.

In the study by Santos, et al. [22], it is shown that in the preventive measures performed by the nursing team, the use of massage is still used, thus showing the importance of training and guidance of the team in order to provide quality care to the client.

With all the debates about concepts, doubts and difficulties reported, it was observed great adherence of the professionals who were members of the sectors where the students performed the action, demonstrating that the objective of sensitizing these professionals within the PPL and their care was achieved.

Dantas et al. [23] emphasizes during their research on the importance of nursing, with the function of educating and guiding within its practice. It should develop educational processes, in the most diverse health environments, in order to favor the development of technical skills in order to qualify nurses to perform a safe practice for both the patient with injury and for him.

IV. CONCLUSION

Playful instruments are facilitated forms of learning, and there was a good interaction and reception by the hospital nursing team. It is essential that the nursing team be trained and updated on the theme of pressure injury.

Nursing demonstrated mastery of the subject, however, there was a considerable deficit in relation to the knowledge of the other professionals of the multidisciplinary team about pressure injuries. In view of this, it is necessary to carry out periodic updates on PPL for the multidisciplinary team.

During the action it was noticed by the students that the playful strategies have an easier support, compared to other methods of EC, thus ensuring a quality learning. In addition, the hospital nursing team reported satisfaction with the action and how important it was to ensure better care.

It is important that there are studies with observational methodologies to evaluate the effectiveness of the playful activities applied by the members of the academic league in this hospital.

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From neighborhood of culture to cultural neighborhood of São Luís: aspects of identity, memory, and territory in the cultural neighborhood of Madre Deus (Stigmas And Perspectives)

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Abstract *- This article aims to understand the process of the cultural formation of the neighborhood Madre Deus, through the categories of identity, memory, and space, as well as to emphasize the direct relationship of the residents as a watershed for the legal recognition of their cultural heritage in São Luís. It also aims to verify the perspectives of the law already in force, concerning socio-economic and cultural changes and possibilities. For this purpose, we are using bibliographic research, virtual research in local media, in addition to our experience in the locus of this research. However, it must be initially concluded that although it has a whole cultural collection of great potential, the formation of the Madre Deus neighborhood and its realities comes from the dynamics between Space, Memory, and Identity that form the social and political bonds of the place and that carrying out the analysis of the three categories mentioned above is what makes the understanding of the process of constitution of the Neighborhood more viable, as well as its relations with the society of São Luís.*

I. INTRODUCTION

In the historical and academic scenarios in which we live, it is very common – and we would even say commonplace – for people to observe social symbols and identities constructed from a specific part of a society to explain and homogenize the whole of that society. One of the social layers that compose that society produces and imposes a reality as a model that, many times, is unrelatable to a large part of the population. This concept is closely related to the idea of National Culture, a notion by Stuart Hall, (2006, p. 50), which says that this concept "is a discourse - a way to build meanings that influence and organize both our actions and the conception that we have of ourselves".

The discourse mentioned by the aforementioned author can be seen in the project of the construction of the Brazilian national identity. This took place even in imperial times, whose interest was to build an imagined national identity, forged from elements that would give materiality to a national memory that,

> Would start to work towards providing this country with visual and affective memory and a new calendar of dates, heroes, and holidays. [...]. It was about finding an honorable 'origin' at a remote time when indigenous people and white nobles coexisted in an equally legendary region lost in an immemorial past. [...]. (Schwarcz, 2011, p. 337).

Based on the discourse of Schwarcz, it is clear that, for the first time in the country, a specific ‘national heritage' forged in aestheticized indigenous peoples was legitimized, ignoring the black and mestizo population of the country, freed or enslaved. In this sense, “there were, therefore, the foundations for this moment of foundation of our culture, which mythically allied the 'natural' and 'nature'. The author emphasizes that “Brazil was never so tropical and exuberant and never so white and indigenous, but never black.” (Schwarcz, 2011, p.341)

But what we observed is that not every attempt to induce facts and behavior is capable of mixing water with oil; even though we are taught the wonders of being Brazilian since childhood (as our fellow compatriots tend to say: “we live in a tropical country, blessed by God and beautiful by nature! After all, God is Brazilian”) our daily lives insist on reminding us of the countless misadventures that these same notions bring us. Brazil, as a society built by many peoples, is marked by the cultural differences of these peoples.

In these terms, when talking about society, Stuart Hall (2006, p. 18) states that these are "characterized by "difference", they are crossed by different social divisions and antagonisms that produce a variety of different "subject-positions" - that is, identities - for individuals'.

Still dealing with national identity, Chimamanda (2019:18) draws attention to the dangers of a single history, forged from narratives that reproduce the interests of hegemonic cultures. For, the construction of narratives of the history of a people implies power. "Power is the ability not just to tell other people's stories, but to make it your ultimate history." Therefore, narratives for the construction of a plural history, based on differences, require different ways of telling stories. “Because stories matter, many stories matter. Stories were used to despoil and slander, but they can also be used to empower and humanize.”

Bearing in mind that the place of memory in our society is almost always institutionalized, that is, that in most cases, what we know as material or immaterial symbols of our historical or cultural memory are officially and externally instituted to the individual; rarely do these symbols fully represent our true individual or collective memory.

Therefore, we can rethink the real significance of what is presented to us as property, heritage, and identity and which element becomes more latent within the historical and social context of individuals: the coercive memory (in a way that others defend what will be relevant that we have as significant memories) or which would be our true memory places.

In this context, the cultural neighborhood of Madre Deus emerges. And even though it is not a forged space, and officially institutionalized with collective memory, converges to itself much of the cultural memory of its residents, neighbors, and sympathizers who autarchically name it as the cultural center of São Luís, and has among its alleys its greatest asset, its “nation” and much of its history, identity and memory, in addition to being the space where intrinsic aspects of its culture are fully exercised.

> The peculiarity of Madre Deus presents a specific form of social production, by proposing a differentiated approach to issues relating to the traditional urban architectural fabric. Even before the Projeto Viva, there was already an organization of popular culture manifestations, with the Carnival and the June circuits involving the community (Carvalho, 2006, p. 43).

The neighborhood of Madre Deus had been known from a very early age as a cultural neighborhood in the city of São Luís, and this concerning its great cultural and intellectual framework found in its effusive calendar of parties, manifestations, ways of living, knowledge, and religiosity.

For the large island of São Luís, the location became even more famous in the 80s and mainly 90s, where it became the focal attraction in the festive periods of Carnival and São João in the city, the neighborhood from then on gained the status of a neighborhood of cultural effervescence, starting to count on more investment and visibility, mainly on the part of the state government, which saw this dynamic as a way to dynamize and promote the economy and tourism during those periods.

Despite the "favorable scenario", all this buzz surrounding the neighborhood was concentrated in seasonal periods, and it was not able to raise the status quo of Madre Deus in a continuous and conjunctural way, and the place was forgotten in other periods of the year and depreciated throughout decades and governments to the detriment of truly institutionalized and official symbols of collective memory and history in the city, especially the cultural district of Praia Grande.

That changed, at least theoretically, on May 28, 2018, when Bill 105/2018, authored by state deputy Roberto Costa (MDB), was approved. It declared the Madre Deus a cultural neighborhood and Intangible Cultural Heritage from the State of Maranhão, the cultural manifestations of the “Grande Madre Deus” region; This denomination also includes neighborhoods adjacent to it, such as Goiabal, Fonte do Bispo, Lira, Belira, Codozinho, and Macaúba. In addition to other 46 popular manifestations.

It is noteworthy that the area of Madre Deus and its community (which autarchically calls itself the "Nação Madre Deus (Madre Deus Nation") consolidate together the ideas of physical, symbolic, and affective space, and inherent and significant issues regarding memory and the identity, these being the main nuances to be studied in this article, combining them with their perspectives regarding the future of this region and its inhabitants. Thus, the central theme of this research follows the following development: the methodological proposal is presented below. The third part approaches the neighborhood of Madre Deus in its historical aspects, considering the tradition and oral memory of the neighborhood. In the fourth moment, the "Nation" Madre Deus and its identity symbols are shown, followed by the approach regarding Madre Deus Cultural District stigmas and perspectives, and finally the final considerations.

II. METHODOLOGICAL PROPOSAL

This research has an Interdisciplinary character since it requires a dialogue with categories from different areas of knowledge such as Geography, Tourism, Sociology, and History. Categories of space, memory, and identity will be studied by using authors such as Tuan, Maurice Hallbawchs, and Stuart Hall respectively, to better understand the process of cultural formation in the neighborhood of Madre Deus in São Luís, Maranhão.

According to Minayo (2013), there is not such a thing as one single good method. What exists is complements to the methods adopted. In this sense, qualitatively, our research aims to be explanatory, in which the means used will be bibliographic, which will guide the entire paper, as we will analyze the latest works from the perspective of our research, in addition to local newspapers, social media. And it will also be empirical since we will use our latest experiences with the complementary research object in this paper.

The production of this work will allow a greater understanding and analysis of the dynamization of the categories of memory, identity, and space in the formation process of the cultural neighborhood Madre Deus.

III. AS IN THE TIME OF OUR GRANDPARENTS

The neighborhood of Madre Deus is located to the southeast of the island of São Luís, formerly known as Ponta de Santo Amaro. It was the place chosen to build a chapel in honor of Our Lady of Madre Deus, the saint that today gives its name to the neighborhood. Such a name not only reveals the strong Catholic influence throughout the city of São Luís in the 18th and 19th centuries but also leads us to reflect on the strong religiosity of those people and how it influenced the formation of the neighborhood.

With the expulsion of the Jesuits from Portugal and their colonies in 1760, their assets were confiscated, and the house of Madre Deus (as it was more popularly known) became the home of the State Government, while the official headquarters were under renovation. In 1811 the Governor's Palace was completed and the house of Madre Deus became the headquarters of the Military Hospital. Today, the former home of Madre Deus houses the Tarquínio Lopes General Hospital. The space built by man translates his needs and enriches human notion and cognition (Chagas, 2002).

The first report about the neighborhood is in the works of Marques (1713)

> On October 4, 1713, in the sítio da roça, in this city, Captain-Major Manuel de Silva Serrão and his wife transferred to Captain-Major Constantino Sá "the pillars, arches, foundations, and other works found on the land bridge called Santo Amaro, made with a license from the City Council to build a church there, and they also granted him the mercy that the City Council had done the same for him[...]. Captain Constantino thought it safer to ask for this same mercy for himself, as it was given to the said Serrao, and requesting the chamber "he said he was making a hermitage for Our Lady of Madre Deus, the dawn of life" and it was granted to him in the council of December 1, 1713[...]". We do not know how it later became the domain of the Jesuits (Marques, 1970, p. 434).

The neighborhood of Madre Deus extended as an urban settlement, up to where there was a municipal slaughterhouse, close to the Bacanga river, which served as a population attraction center for people from other cities that were looking for alternatives of survival. In an interview with Zé Toinho in a research carried out by Abmalena Sanches, he finds "The ancient Madre Deus, it was where the FEBEM building is today, it was an old slaughterhouse. So Madre Deus was a neighborhood that was born out of these people, cattle killers, and fishermen. These people who do some things, some events to have fun". (SANCHES,)

But the fishing was not Madre Deus's only economic activity. At the end of the 19th century and the beginning of this century, the neighborhood began to receive workers, attracted by the installation of textile factories there: Companhia de Fiação e Tecidos de Cânhamo (CEPRAMA) and the Companhia de Fiação e Tecelagem São Luís, and Fábrica Santa Amélia. Some slums located on the street of the Crioulas and the street São Pantaleão

are witnesses to that period. These were areas where small rooms were built and rented to factory workers (Chagas, 2002).

We believe, based on these data, that already at that time a settlement was formed near that place, which with their memories and their identities, shaped its space over the centuries, forming the neighborhood we know today. It can be seen that it was with the construction of the Bacanga Dam and the dissociation of the factories in the area that most of its residents migrated to other regions, however, those who settled there found a bond of identity in the festive character of the region. The parties of the neighborhood depended on this community to happen, the residents were the actors and the audience of their shows; their moment is found there, their time to feel represented. As explained by Caillois (1988), regular life, busy with the daily works, peaceful, subject to a system, full of concerns, in which the maxim maintains order in the world, is opposed to the effervescence of parties.

Seeking to understand the bases of support of a group, in social, cultural, or economic spheres, is not a recent proposal within the academic universe of academic activity, however, it is worth observing how this process can take place so that research happens in a complete format, encompassing the due aspects related to the object, it can become slippery when it is not covering the rest that makes up the globality of the existing relationships in these communities; for this reason, in addition to showing the festive Madre Deus, this paper also seeks to relativize and contextualize within a larger scenario the many particularities of the complex place.

It is mainly in the festive character that Madre Deus sees and represents itself as a link of identity within her community, filling even more mechanisms for the operation of social and affective bonds. Perez (2002) suggests that parties are a multiverse configured as a polyphony of social voices and different formats of organization and celebration.

In this paper, Madre Deus also appears like a neighborhood community that benefits from its state of festive contemplation to increase their businesses that help their livelihood, such as bars, small restaurants, cafeterias, and shops, which are busier during periods such as Carnival and São João, periods in which the neighborhood is visited by people from all regions of the city.

In these terms, the theme of memory gains importance when we look at the Madre Deus Cultural District. Because its memory could not be recovered from the past if it had not been preserved, through the permanence of space and of its identities. Each street, each property, awakens us to the daily life of the past, a memory, where reflection is capable of reproducing constitutive memories of the cultural neighborhood (Halbwachs, 1990).

Concerning constitutive memories, it is possible to consider the importance of the collective memory of a place, in this case, the cultural neighborhood of Madre Deus. It is important to realize that these memories need to be formed considering the collective, to obtain facts, as well as narratives, which can integrate to the sense of the other and thus contribute to the materialization of memory in the present time and its given space (Halbwachs, 1990).

IV. TRADITIONS AND ORAL MEMORY IN THE CULTURAL CENTER

The old Madre Deus

Is the flower of São Luís by nature itself

Its batucada is what ends with sadness

A dynasty, a group of sambistas

Tradition of royalty

Whoever knew her won't forget the fights of

Zezão and Zé Bedeu

Don't hurt the flower

Madre Deus is a garden of Love

Don't hurt the flower

Hanging garden that nature created".

(CABOQUINHO - MADREDIVINE POET).

The memory of a people must be made up of many recollections, but also many lapses; this is something that we easily perceive in the Cultural Neighborhood of Madre Deus that, despite having several problems, finds in its parties, in its joy and in its manifestations, the driving force that guides its lives: at a given moment - the moment of riptide – these people feel free from their problems, to give voice and space to the joy and festive character that is intrinsic to that region; being represented by these, but also represented through them their reality.

> At many times; Maurice Halbwachs insinuates not only the selectivity of all memory but also a process of "negotiation" to reconcile collective and individual memories: "For our memory to benefit from that of others, it is not enough for them to bring us their testimonies: it is also necessary that it has not failed to agree with its memories and that there are enough points of contact between itself and the others so that the memory that others bring to us can be reconstructed on a common basis." (Pollak, 1989).

Durkheim (1989) points out that festive moments, as well as producing a state of effervescence, also serve to maintain the vitality of collective beliefs, preventing their disappearance from the social memory of different human groups.

The Madre Divina Community mainly uses its traditions and its oral memories passed from generation to generation to refer to its deeds and its social constructions. It is commonplace to hear groups in the streets and sidewalks talking about the pioneers and how they contributed to the creation not only of the neighborhood but also and mainly to the creation of its cultural manifestations, and these are undoubtedly the main reasons for pride among these families.

"Cê sabe Seu Beto, neto do fundador do boi da Madre Deus; Gersinho, aquele filho do fundador da Turma do Quinto."; the history related to the pioneers serves more than a simple and basic narration of the life and work histories of the families, it almost becomes a surname, a title, something that identifies and differentiates you from others in the community, guaranteeing them in the process a distinctive status quo within the group.

Each location, each manifestation refers to a place of memory that is simultaneously representative for its own collectivity, and unique for each individual; another interesting point to be observed is the difference in perceptions and memory relationships that we observe between its residents (actors and protagonists of everyday life) and its visitors; the first ones understand and know it in its qualities and virtues, in its golden moments and those of depreciation and forgetfulness, they live together and represent it, therefore they have a distinctive look, thus possessing different references to memories; the second, the visitors almost always from seasonal periods, have access to the site during festive moments, relating to the neighborhood memory ties linked to the joy and hospitality of its residents, knowing very little about aspects such as what you want to forget or not show to the general public, consequently the memories and stories of the region do not always converge equally for all its audiences and characters. In these moments, as in a job interview, Madre Deus shows only its best aspects, trying to hide or minimize as much as possible its "flaws".

As said by Pierre Nora (1993, p 9):

> Memory installs remembrance in the sacred, history sets it free and makes it always prosaic. Memory emerges from a group it unites, which is to say, as Halbwachs did, that there are as many memories as there are groups; that it is, by nature, multiple and decelerated, collective, plural, and individualized. History, on the contrary, belongs to everyone and to no one, which gives it a vocation for the universal. Memory is rooted in concrete, in space, in gesture, in the image, in the object. History only links temporal continuities to the evolutions and relationships of things. Memory is absolute and history only knows the relative.

V. MADRE DEUS: FROM THE PHYSICAL SPACE TO THE CULTURAL NEIGHBORHOOD

With the construction of the Bacanga Dam, the Tabatinga beach was grounded, which diminished fishing activity, as it caused the boats that used to dock there to dock at Portinho, causing the majority of its population to migrate to new residential areas such as Anjo da Guarda, Vila Embratel, and Vila Nova.

The landfill process of the Bacanga River significantly impacted the Cultural District of Madre Deus. These transformations reveal how much space was shaped throughout the 19th to the 21st century by the population of São Luís. However, the inhabitants of the Madre Deus neighborhood were directly part of this new space, since the effects of this transformation of the space corroborate the dynamization and perpetuation of their memories and identities. (Chagas, 2002).

It is worth mentioning that most of the residents of Madre Deus were workers in the factories mentioned in this research, it is important to understand the before and after of the lives of these residents with the grounding of the Bacanga River, which will lead us to understand how much the space transformations had concrete effects on the lives of the individuals residing in this environment (Tuan, 1983).

The textile industries, fishing, and slaughterhouse corroborated another peculiarity of the place. The State of Maranhão became the 3rd largest industrial park in the country, with several of these factories installed close to the neighborhood, however, the decline of these companies accentuated the socio-economic imbalances, and encouraged the change of part of the population from the neighborhood to other areas.

According to Araújo (1986, p. 38)

> There are two categories of residents in Madre Deus: the old ones who form a traditional niche, who remained due to prestige, investment, and family ties, and the more recent residents, attracted by the frequent festivals that enable the trade of cultural subsistence.

The territorial dimension that, according to Lamas (1993), is composed by the city itself. On this scale, the shape of cities is structured through the articulation of

different forms to the urban dimension with different neighborhoods linked together. The neighborhood of Madre Deus is surrounded, in its mediations by a set of small neighborhoods such as Lira, Belira, Codozinho, Goiabal, Macaúba, São Pantaleão, Fonte do Bispo, Vila Passos, Vila Bessa, Santiago, and part of Areinha.

Following the example of the rest of the country, which brings together in just one zone, or neighborhood, tourist activity of a cultural and historical character, the city of São Luís has the Praia Grande area as the main center representing the cultural elements of the city, neglecting other regions that, even if not included in the collective memory, are popularly recognized as cultural strongholds of their people and that demonstrate great potential for the implementation, promotion, and growth of tourism in the city.

Currently, if ideologically the Praia Grande is considered one of the greatest landmarks of the culture and the and economic history of São Luís, the Madre de Deus is defined as the greatest centralizing center of popular culture in the capital. Since the beginning of the 20th century, Madre Deus has been consecrated as the stage for folkloric and artistic manifestations of popular culture in Maranhão.

Thus, the description of the place, of established social practices, helps to build the web of images and relevant and essential meanings for the people who build and experience the place (Santos, 2007). The space, therefore, becomes dynamic through the individuals belonging to this space, thus making it fundamental and even the starting point for the emergence of the place, as well as the understanding of what it will be in the future.

VI. THE NATION OF MADRE DEUS (IDEAS AND SYMBOLIC IDEALS OF IDENTITY)

At some moments in our lives, we are asked to do something that may seem relatively easy: describe who we are, including a self-analysis of our main strengths and weaknesses, and also our perception of the other; It is easy to see in these moments how easy it is to attribute (or not) values and highlight significant points in the other, a task that becomes complicated when we talk about ourselves.

This can be a cultural trait, since talking, observing, and criticizing the "other" may seem much more interesting to us, however, this can also serve as self-criticism, so that we can learn to observe ourselves as protagonists of our history, analyzing through a magnifying glass our main qualities, and with greater difficulty our greatest vices and weaknesses, including ourselves too.

In the Madre Deus neighborhood, in a misappropriation, the community calls itself “Nação Madre Deus”; in a more simplistic view then, we could say that these are constituted of a community or group of individuals of common preference or sympathy; but when perceiving closely the aspects that surround them, we can see that they use this term in the broadest sense of the word, that is, as the idea of homeland, tribe or native country; these see and recognize themselves as a “whole” within a part, as a singular group with well-defined characteristics, who are proud of it.

In this perspective, identity has the power to shape feelings, values, and a multitude of items encompassed in the most varied societies in the world, thus presenting a reflection of human coexistence. Such is its importance, as it portrays a vividness of social relations and symbolic heritage that when shared historically establish the union of certain values between the members of a society. Thus, we can understand the constitution of identity in manifestations that can be developed in a wide range of situations, ranging from ways of speaking to participation in events.

According to Magnana (1990 in Araujo, 2006, p. 177) “[...] culture was not constituted of cults and customs, but of structures of meanings, through which men shape their experiences”. We can understand that these experiences are acquired in everyday life through individual and collective actions. It is through this action that human achievements are expressed, which must be respected and preserved for their meanings. Great diversity in its varied manifestations must be preserved and encouraged. In the space and time in which the memory is projected as a source of the formation of cultural identities.

Stuart Hall states that: “[...] national identities are not things we are born with but are formed, transformed on the inside of representation” (Hall, 1999, 48). It is believed that this nation the author speaks about is built from a symbolic community and generates feelings of identity and belonging that do not necessarily have to be the geographic limits that this nation imposes. Thus, this construction of identity or entities is shaped when a certain group appropriates its values and manifestations, perpetuating them in its history, passing from generation to generation.

Menezes (2014, p. 68) states that “thinking about identity, or identities, means reflecting on intra and extra group ties, the process of defining belonging and difference, the symbolic and material production of borders.” Thus, this construction of identity or entities is shaped when a certain group appropriates its values and

manifestations, perpetuating them in its history, passing from generation to generation.

VII. MADRE DEUS AS A CULTURAL NEIGHBORHOOD ((STIGMAS AND PERSPECTIVES)

In general, when we look at the definition of neighborhood, we find that most of the time it is defined as a simple territorial division of a city; as stated by Aulete (1948), who considers neighborhood as being each of the main zones into which a city is divided, or simply a portion of territory in the vicinity of an urban nucleus. Ximenes (2000, p. 112) and Almeida (1981, p. 420) practically follow the opinion of the author, expressing, respectively, similar definitions: "Each of the major divisions of a city" and "Each of the main divisions of a city; portion of the territory of a village".

Lefebvre (1975) interprets the neighborhood as a concrete form of space and time in the city, which acts as a social module of greater convergence between the geometric space and the social space, between the quantified and the qualified.

In other passages, we notice the concern with the question of the identity of the individual to this spatial unit. In one of his reports, Sousa (1987, p. 57) states that [...] in addition to a certain territory, the neighborhood is characterized by a second element, the "sense of locality" existing in its residents, and whose formation depends not only of geographical position but also of the interchange between families and people, who wear the topographical skeleton. [...] What is a neighborhood? -I once asked an old caipira, whose quick answer expresses in a sentence what has been exposed here: - a neighborhood is a small nation. – that is the portion of land to which residents are aware of belonging, forming a certain unit different from others.

Following this context, shown by Sousa, Madre Deus is perceived not only in the physical and spatial dimensions but also in terms of social and cultural relations. Much bigger than the physical character, the neighborhood brings together aspects that surround the experience of this population.

Differently from other neighborhoods, in this study, we can observe the strong implementation of the cultural and human character in the constitution of this sphere, which previously could only be understood as a merely physical space.

In this perspective between what should be remembered and forgotten, between what is speakable and unspeakable, since the 1990s the neighborhood has gone through moments of inconstancy concerning the implementation of public policies.

In 1998 the Government of the State of Maranhão created the "Viva Bairros" project as part of the "Cidade Viva" program, the main objective of this program was the urban reintegration of public areas in São Luís with the participation of community groups; the renovations took place basically in a structural way, to Madre Deus, or more precisely the "Largo da Madre de Deus or Largo do Caroçudo", the design and structure it has today, and it was chosen to be the prototype for the implementation of the Project Viva Bairros, totally changing its look and harmonizing its entire architectural ensemble. As Cruz (2002, p. 54) says: "Territorial planning in the configuration of places results from the necessary rationality imposed by the market as well as the spatial competitiveness between places, which is characteristic of today".

Later in the 2000s, the region gained the title of a cultural neighborhood, something that only becomes de facto and de jure on May 28, 2018, after the approval of Bill 105/2018 that declared the Madre Deus a cultural neighborhood and the cultural manifestations of the "Grande Madre Deus" region as Intangible Cultural Heritage of the State of Maranhão, recognized for its cultural strength not only by its residents and supporters but also by the entire Maranhão community.

> We know that the Madre Deus region is a cultural center that brings together carnival and June events, in addition to other festivities and celebrations. A place that serves as an inspiration for poets and composers and is secular in its tradition. The Madre has an open heart to receive those who come to it to live moments of celebration, joy, and relaxation, celebrating life. Therefore, let us do justice to this honorable and recognized tribute. (Roberto Costa (MDB), state deputy author of the project)

At the same time, the state government instituted, through Decree 34,959, in 2019, the "Nosso Centro Program", which has among its priorities the revitalization of important points in the Madre Deus area, such as squares and churches, the formalization of cultural groups, as well as encouragement to the creation of cultural centers.

The observations that must be made about these interventions made to the Madre Deus neighborhood must be related to what is prioritized and what is neglected in these processes.

It should be taken into account that many times the basic structure, the development of a social and educational nature that offers the quality of life to the local

population, has not undergone major changes, remaining with the repercussion of neighborhood stigmas, present and known as the face not so festive of the community, with problems related to drugs, garbage, and marginality. Becoming an Intangible Cultural Heritage, for example, can cause an expectation of transformation of reality for the residents that is different from what is done.

Now, the positive points of the actions of the "Projeto Viva Bairros", the "Nosso Centro Program" and the title of Cultural and Intangible Heritage, it is possible to relate it with the perspective of valuing the local cultural heritage, since, as we know, the neighborhood of Madre Deus is a place that possesses both material and immaterial cultural assets. It is also known that when it comes to the symbolic representation of the city of São Luís, the attention received by the Praia Grande neighborhood has always been greater, not extending to Madre Deus and its surroundings in the same way. This reality can be attributed to issues such as the formation of memory having been based on the wealth and glory of the city in the colonial period since the space where the Praia Grande neighborhood is located had great commercial prominence in this period.

In the current scenario, the intention in relation to these public policies that result in benefits such as revitalization and requalification of the physical space, as well as the promotion of culture and economy, we must point out another important point to be considered in the reality of Madre Deus, which is its touristic appeal.

When talking about Tourism, it is possible to highlight the merit of a chain that grows and is yielding more and more at the economic level, due to the fact that it manages to reach and move several social spheres. In the words of Boulhosa and Vasconcelos (2019):

> Tourism, in recent decades, has stood out as one of the most important socio-economic activities of contemporary society, increasingly part of the lifestyle of many people who travel the world for leisure, culture, adventure, sport, nature, among others.

From the beginning, Tourism has been a driving tool in the development of societies. The opportunity for cultural exchange and economic propulsion, among other factors, gives this industry great relevance on the world stage. According to Ferreira (2005,12): "Human beings, historically, have always had the habit of traveling and getting to know other lands, other peoples and other places, unraveling their habits, cultures, and way of acting. Modern societies have made this natural curiosity an extremely profitable service, generating income".

Thus, when we associate the actions of public programs and projects with the possibilities of tourist activity, we can achieve the appreciation of the heritage and the benefits arising from these initiatives, as in addition to promoting the conservation of the space, it also contributes to boosting the local economy and active participation of the community.

VIII. CONCLUSION

Through what has been shown here, we can conclude that when we associate the elements of space, identity, and memory in the context of the Madre Deus neighborhood, several nuances are discovered regarding this object of study.

Regarding identity, it is possible to see that in this location there is an education rooted in social relations that build symbols based on the production, mainly cultural, of the place, strengthening the idea that a society with legitimate representations has the opportunity to elaborate and conceive this representativeness.

In Madre Deus, where even "silence is revelry", we can observe that bonds of affection and belonging within the community are closely related to memory ties shared not only in the construction and development of the neighborhood but also in the shared memories of their knowledge and modes of expression, which converge as an equalizer for this community to elaborate their stories and their symbolic myths of the neighborhood.

Memory and orality play an indispensable role in this community, which has in its memories and the transfer of its knowledge to the younger generations, a form of social and cultural reaffirmation, in the expectation of "not letting the sambar die", not letting their stories and their "way of making culture" die among the younger generation, something that seems very difficult to achieve, given the little interest and engagement of younger people in all these processes.

The most interesting thing to note is that even today, contrary to the current context of the city life of speed, rush, lack of time, and chaos – in which neighbors of years and years do not even know each other, or just speak politely in mandatory, fast and casual social interactions – we see in this community, daily, chairs at the doors and circles of conversations in the streets, in a wanted social relationship that is commonplace and even stimulated, transporting us in an anachronistic way, to a slower time, a time of memories, memories made when they are counting their deeds and sharing stories, memories created and passed on collectively but also unique memories built on their old and current experiences and coexistences.

In the physical landscape of cities, there is a spatial division of territory where social and cultural relations are usually created. Greater than the physical character, the neighborhoods bring together aspects that surround the experience of these populations. Differently from other areas, in this study, when thinking about Madre Deus as a Cultural Neighborhood, we can observe the strong implementation of the cultural and human character in the constitution of this sphere that before could only be understood as a merely physical space.

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Yield and physicochemical characteristics of west indian cherry genotypes grown in the semi-arid region

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***Abstract*—** *This study aimed to evaluate the yield and physicochemical characteristics of three West Indian Cherry genotypes cultivated in the semi-arid region of the state of Piauí, Brazil. The experiment was conducted in a randomized block design (RBD) with three replications and three treatments, corresponding to the West Indian Cherry genotypes 'Clone 14', 'BRS 366 Jaburu', and 'Junko' cultivated in a 4 x 3 m spacing. Combined genotype analysis revealed the following mean variations: yield from 22.96 to 47.53 t ha -1; fruit mass from 4.18 to 5.52 g; longitudinal diameter from 20.28 to 22.80 mm; transverse diameter from 17.32 to 18.42 mm, pulp yield from 27.58 % to 34.54%; red Hue° varying from 19.00° to 26.00°; soluble solids from 7.2 to 8.1 °Brix; titratable acidity from 0.82 to 1.34; ratio of total soluble solids to titratable acidity from 5.00 to 10.37; pH from 3.52 to 3.74; total anthocyanins from 2.56 to 12.11 mg.100 g-1 of pulp; flavonoids from 4.30 to 7.44 mg.100 g-1 of pulp; lycopene from 0.30 to 4.71 mg.100 g-1 of pulp; β-carotene from 14.00 to 32.51 mg 100 g-1 of pulp; mean ascorbic acid content of 2.676 mg.100 g-1 of pulp. Under the present experimental conditions, "BRS 366 Jaburu" was the most promising among the studied genotypes.*

I. INTRODUCTION

The physicochemical characteristics of West Indian Cherry grown in different regions have been extensively studied, especially with regard to its high nutritional potential. These fruits are rich in ascorbic acid (Cruz et al., 2019), carotenoids, flavonoids, and anthocyanins (Prakash & Baskaran et al., 2018), which has encouraged the expansion of West Indian Cherry cultivation in Brazil in recent years.

The ascorbic acid content, a basic parameter used to select West Indian Cherry fruits, as well as titratable acidity (TTA), total soluble solids (TSS), and pH are influenced by the geographic location of the growing region (Neto et al., 2014), the fruit maturation stage (Nasser et al., 2014; Estevam et al., 2018), harvest season (Nasser et al., 2018), crop management practices, and genetic factors (Souza et al., 2020). Therefore, studies on the characterization of new genotypes deserve more attention as West Indian Cherry production is directly influenced by the environmental conditions of the location where the orchard stands.

Due to its rusticity, West Indian Cherry adapts well to tropical and subtropical climate regions. The optimum temperature for its cultivation ranges between 15 °C and 32 °C, with halted growth and development at temperatures from 10° to 14 °C (Prakash & Baskaran et al., 2018). The optimum cumulative rainfall range for appropriate fruit development varies from 1,200 to 2,000 mm year-1. Cultivation should be complemented by irrigation in regions with less than 1,200 mm year-1 (Dias et al., 2020).

From this perspective, the semi-arid region of Piauí shows appropriate conditions to establish fruit orchards, with favorable edaphoclimatic conditions for West Indian Cherry cultivation, such as a mean annual temperature of 27 °C, mean rainfall from 1,000 to 1,200 mm year-1, and mineral, homogenous, well-drained, deep soils with a low slope, favoring the position of the area with regard to the incidence of solar radiation.

Therefore, this study aimed to characterize and select West Indian Cherry genotypes with promising agronomic characteristics for cultivation in the semi-arid region of Piauí, Brazil.

II. MATERIALS AND METHODS

The study was conducted from September to October 2019 at the experimental orchard of the Fruit Growing Study Group of the Federal University of Piauí, Campus Professora Cinobelina Elvas (UFPI/CPCE), in the city of Alvorada do Gurguéia, Piauí, Brazil, at the coordinates 08° 22'24.89 S and 43° 51'11.89" W, and 231 meters above sea level. The climate of the region is classified as Aw (tropical megathermal), with dry winters (Alvares et al., 2014). The meteorological data of the study area were obtained daily throughout the experimental period by the National Institute of Meteorology (INMET, 2019) through an automatic weather station in the city of Bom Jesus, Piauí (A336).

The study was conducted in a randomized block design (RBD) with three replications and three treatments, corresponding to the West Indian Cherry genotypes 'Clone 14', 'BRS 366 (Jaburu)', and 'Junko', with the experimental unit consisting of three plants of each genotype.

The study was developed with one-year-old West Indian Cherry genotypes in a 4 x 3 m spacing (833 plants ha-¹), planted on February 27, 2018, in a Yellow Latosol with clay loam texture (Santos et al., 2013). Irrigation was supplied daily with a micro-sprinkler system at a flow rate of 40 L/h. The physical and chemical characteristics of the soil before the experiment was established are shown in Table 1.

Table 1: Physical and chemical characteristics of the soil at a depth of 0-20 cm in the West Indian Cherry cultivation area, February 2018, in Alvorada Gurgueia, Piauí.

H^+	H^+Al^{3+}	Al^{3+}	Ca^{2+}	Mg^{2+}	K^+	T	P	K^+
H_2O	----------mg.dm^{-3}----------						mg.dm^{-3}	
5.7	1.71	0	1.28	0.17	0.15	3.3	3.68	57.1

Cu^{2+}	Fe^{2+}	B^+	Mn^{2+}	Zn^{2+}	V	M.O	Clay	Silt	Sand
----------mg.dm^{-3}---------					%	%	g/kg	g/kg	g/kg
2.37	53.28	0.59	37.23	1.7	48.1	6.5	64	29	907

P, K, Cu, Fe, Mn and Zn - Mehlich Extractor 1; Ca, Mg and Al - KCl Extractor - 1 mol/L; H + Al - Calcium Acetate Extractor at pH 7.0; Organic Matter (OM) - Walkley-Black method.

In July 2018, the apex of the main stem was pruned at 50 cm from the soil to promote sprouting and form new structural branches. Subsequently, three branches were selected to shape the plant architecture throughout the vegetative period by pruning them at 40 cm from their insertion in the main stem. The branches were brushed with 1% copper acetate solution for preventive disease control in both periods after pruning. Moreover, 5L of bovine manure was added to each plant to improve the physical and chemical characteristics of the soil.

Production fertilization was performed 30 days after pruning based on soil analysis (Table 1) and the fertilization recommendations for the crop, being superficially incorporated over a 40 cm strip corresponding to the plant canopy projection. Micronutrient fertilization was performed by foliar application every 30 days, with the first at the beginning of sprouting, using 200 mL 100L-1 of the commercial micronutrient Ativax®, composed of 2% S, 1% Mg, 1% Zn, 0.50% Mn, 0.50% Fe, 0.50% B, 0.30% Cu, and 0.10% Mo, totaling four applications.

Weed control was performed mechanically during the crop cycle. Phytosanitary treatments were performed whenever necessary according to the need of the plants. The evaluations were performed after the flowering from September to October 2019, when the plants achieved the first production.

The ripe fruits were harvested early in the morning and transported in isothermal boxes to the Plant Propagation Laboratory of the Federal University of Piauí, *Campus* Professora Cinobelina Elvas (UFPI/CPCE). Subsequently,

the fruits were evaluated with regard to yield (t ha-¹) and the following characteristics:

Physical characteristics: fruit mass (g), longitudinal (mm) and transverse diameters (mm), measured with the aid of a digital caliper; pulp yield (%), obtained by the difference between fruit weight and residue weight; and color appearance (Lightness (L*) Chroma (C*) and Hue Angle (°h)) (Mcguire, 1992);

Chemical characteristics: TSS, total soluble solids (°Brix), TTA, total titratable acidity (g malic acid.100-¹), TSS/TTA ratio, ascorbic acid (mg.100 g-¹), determined by titration using 2,6 dichlorophenol indophenol; pH, according to the methodology described by AOAC (1997); anthocyanins, flavonoids, lycopene, and β-carotene, determined according to the method proposed by Lees & Francis (1972).

The data were subjected to analysis of variance (ANOVA). When significant, the data were compared by Tukey's test at 5% probability using the software R, version 3.2.5, with the statistical package ExpDes.pt (R core team, 2020).

III. RESULTS AND DISCUSSION

With regard to the quality of West Indian Cherry fruits, Table 2 shows that there was no difference by Tukey's test at $p<0.05$ of significance in the mean fruit mass, longitudinal and transverse fruit diameters, and pulp yield, varying from 5.52 ± 4.18 g, 22.80 ± 20.28 mm, 18.42 ± 17.32 mm, and 34.64 ± 27.58 %, respectively.

Table 2: Physical analysis in fruits of three West Indian Cherry genotypes cultivated from September to October 2019 in Alvorada Gurguéia, Piauí.(FM) fruit mass, (LD) longitudinal diameter, (TD) transverse diameter (PY) pulp yield.

Genotypes	FM (g)	LD (mm)	TD (mm)	PY (%)	Yield (t ha-¹)
JUNKO	4.18a	20.28a	17.32a	34.64a	22.96c
BRS 366	5.52a	22.80a	18.42a	31.62a	37.92b
CLONE 14	4.61a	21.31a	18.15a	27.58a	47.53a
FV (%)	18.68	6.45	7.50	12.84	5.7

Note: Means followed by the same letter in the column do not differ by Tukey Test at $p>0.05$ probability.

The mean diameter values found for the studied genotypes were similar to those reported by Lima et al. (2014) when studying six West Indian Cherry genotypes, observing a variation from 0.84 to 0.92 mm, highlighting that West Indian Cherry is a subglobose drupe fruit.

Despite these results, a higher fruit yield was observed for genotype 'Clone 14', with 47.53 t ha $^{-1}$, followed by genotypes 'BRS 366 Jaburu' and 'Junko', with 37.92 and 22.96 t ha $^{-1}$, respectively, in the first year of cultivation. According to the Company for the Development of the São Francisco and Parnaíba Valleys (Codevasf, 2016), West Indian Cherry production in regions with a semi-arid climate only stabilizes after the third year of cultivation, with a mean yield of 24.97 t ha^{-1}. This demonstrates the potential for cultivation of the southeast region of Piauí as the first year already provided results above the expected average.

Fruit color varied significantly between the studied genotypes, ranging from intense red to bright red (Table 3). According to the Hue° angle, genotype 'BRS 366 Jaburu' showed higher values of lightness (38.16 ± 31.07*), saturation (47.67 ± 28.32*) and red color (26.00 ± 19.00°). Similar values were found by Lima et al. (2014) when evaluating West Indian Cherry fruits in the municipality of Muzambinho-MG, reporting lightness values varying from 42.25 to 35.77 and saturation from 48.23 to 39.88.

Table 3: Fruit color means of three West Indian Cherry genotypes cultivated from September to October 2019 in Alvorada Gurguéia, Piauí.

Genotypes	Lightness (L*)	Chroma (C*)	HUE angle (h°)
JUNKO	32.68ab	31.50b	19.00b
BRS 366	38.16a	47.67a	26.00a
CLONE 14	31.07b	28.32b	21.00ab
FV (%)	5.73	6.87	8.30

Note: Means followed by the same letter in the column do not differ by Tukey Test at $p>0.05$ probability.

The presence of these colored compounds in fruits is conditioned by pigments such as carotenoids, which normally range from yellow to orange, and lycopene, evidencing the red color (Neto *et al*., 2014). Color is one of the most attractive quality attributes for the consumer as the visual impact caused by this variable may determine its preference (Lima *et al*., 2014).

The soluble solids content differed statistically, showing higher values for genotypes 'Clone 14' and 'BRS 366 Jaburu', with 8.13 ° Brix and 7.83 ° Brix, respectively. In turn, genotype 'Junko' showed 6.43 ° Brix (Table 4). According to Martins *et al*. (2016), soluble solids values in West Indian Cherry cultivated in Piauí, as a function of

climatic conditions, vary from 5 to a maximum of 12 ° Brix, with a mean value around 7.0 or 8.0 ° Brix. Therefore, the studied genotypes were within the expected parameter.

With regard to titratable acidity, genotypes 'Clone 14' and 'Junko' showed the highest values, with 1.37 and 1.33 g malic acid.100-¹ of fruits, respectively. In turn, 'BRS 366 Jaburu' showed 0.82 g malic acid.100-¹ of fruits (Table 4). This is due to the accumulation of organic acids during fruit ripening (Corrêa *et al.,* 2017), verified by the TSS/TTA ratio of West Indian Cherry fruits (Table 4), according to which the studied genotypes showed contrary results to those observed in titratable acidity.

Table 4: Chemical analysis, total soluble solids (TSS), total titratable acidity (TTA), ascorbic acid (AA), and potential of hydrogen (pH) in fruits of three West Indian Cherry genotypes cultivated from September to October 2019 in Alvorada Gurguéia, Piauí.

Genotypes	JUNKO	BRS 366	CLONE 14	FV (%)
TSS (° Brix)	6.43b	7.83a	8.13a	3.54
TTA (g malic acid.100-¹)	1.33a	0.81b	1.37a	5.74
TSS/TTA	4.84b	9.59a	5.95b	6.88
Ph	4.25a	3.74b	3.52b	2.54
AA (mg.100 g-¹)	2164.00b	2675.67a	1693.33c	6.76

Note: Means followed by the same letter in the line do not differ by Tukey Test at $p>0.05$ probability.

The ratio of total soluble solids to titratable acidity (TSS/TTA) determines fruit flavor, that is, the sweetness and free acid content of fruits. Thus, the higher this ratio, the sweeter the fruits tend to be (Estevam *et al.,* 2018). According to Repolho *et al*. (2019), the TSS/TTA ratio is the most important post-harvest parameter as it indicates the balance between the sugar content and the acid content in the pulp, corroborating the pH results obtained.

Genotypes 'Clone 14' and 'BRS 366 Jaburu' showed lower acidity, with pH values of 3.52 and 3.74, respectively, while 'Junko' showed 4.25 (Table 4), corroborating the fact that West Indian Cherry is considered a slightly acid fruit, with a low and little-variable pH that decreases with fruit ripening (Repolho *et al*., 2019). These characteristics are interesting for industrial fruit processing.

According to Normative Instruction No. 1, of January 7, 2000, West Indian Cherry fruits meant for industrial processing should have a minimum pH of 2.8, 80% pinkish or reddish skin color, measure more than 15 mm in diameter, minimum weight of 4 g / fruit, good firmness, and absence of mechanical damage (Lima *et al*., 2014).

Genotype 'BRS 366 Jaburu' showed the highest ascorbic acid content (vitamin C), with 2,675.75 mg.100 g-¹ of pulp, differing statistically from 'Junko' and 'Clone 14', with 2,164 and1,693.33 mg.100 g-¹ of pulp, respectively (Table 4). According to Neto *et al*. (2014), more acidic West Indian Cherry genotypes show higher vitamin C contents, corroborating the results observed in this study and in study conducted by Carvalho et al. (2018), when evaluating the vitamin C content of fruits produced organically in Petrolina PE, quantifying 2,307.57 mg.100 g-¹ of pulp in this same genotype ('BRS 366 Jaburu').

The vitamin C content in West Indian Cherry genotypes is highly variable, ranging from 779.0 to 3,094.43 mg.100 g^{-1} of pulp. Variations within the same species are due to factors such as the cultivar, type of soil, climatic conditions, and crop management practices (Carvalho *et al.,* 2018). According to the Brazilian Fruit Institute (1995), the minimum value demanded by industries with regard to the ascorbic acid content for import is 1,200 mg 100 g^{-1} of pulp, while export to Europe and Japan requires a minimum of 1,000 mg of ascorbic acid per 100 g of pulp.

In addition to being rich in ascorbic acid, West Indian Cherry is also a significant source of anthocyanins, flavonoids, lycopene, β-carotene, and other carotenoids, which, in addition to the activity of provitamin A, participate as antioxidants in the biological system, decreasing the risk of degenerative diseases such as cancer, cardiovascular diseases, cataract, muscle atrophy, and strengthening the immune system (Silva *et al*., 2013).

With regard to fruit color, all evaluated pigments showed a statistical difference by Tukey's test at $p < 0.05$ of significance (Table 5). However, genotype 'Clone 14' did not stand out with regard to any of the evaluated pigments (Table 5). The content of anthocyanins and β-carotene was higher in genotype 'Junko', with 14.44 and 32.50 mg.100 g-¹ of pulp, respectively (Table 5). Genotype 'BRS 366 Jaburu' showed the highest content of flavonoids and lycopene, with 7.44 and 4.71 mg.100 g-¹ of pulp, respectively (Table 5). According to Cruz *et al.* (2019) and Marques *et al.* (2017), these values are within the expected range from 3.68 to 13.74 mg.100 g-1 of pulp.

*Table 5: Mean pigmentation levels in fruits of three West Indian Cherry genotypes cultivated from September to October 2019 in Alvorada Gurgueia, Piauí.(A) anthocyanins, (F) flavonoids, (L) lycopene, (*β) β-carotene

Genotypes	A	F	L	β
	- - - - - - - mg.100 g-1- - - - - - -			
JUNKO	14.44a	5.71b	0.30c	32.50a
BRS 366	2.57c	7.44a	4.71a	14.99b
CLONE 14	6.57b	4.60c	1.60b	17.14b
FV (%)	8.45%	5.52%	19.44	21.08

Note: Means followed by the same letter in the column do not differ by Tukey Test at $p>0.05$ probability.

The quantification of pigments such as anthocyanins, flavonoids, lycopene, and β-carotene is extremely important as these data, especially in fruits, are insufficient even at a world level (Dala-Paula *et al*., 2019). Anthocyanins and flavonoids encompass the classes of natural pigments found often in plants. The contents of anthocyanins and flavonoids in fruits are genetically determined and influenced by factors such as the season, soil composition, and maturation stage, becoming highly unstable at high temperatures (Estevam *et al.*, 2018).

In turn, lycopene and β-carotene are carotenoids with antioxidant action found in larger quantities in the fruit skin, providing the color from yellow to red, which increases considerably with ripening. According to Silva *et al*. (2013), warmer regions, such as the one of the present study, result in higher carotenoid contents in fruits.

IV. CONCLUSION

Given the edaphoclimatic conditions of the southeast region of Piauí, the studied genotypes showed promising features for cultivation. The genotype "BRS 366 Jaburu" stood out with regard to the studied agronomic parameters, with bright and intense red fruit color, good TSS/TTA ratio, higher content of total soluble solids, flavonoids, lycopene, and ascorbic acid, resulting in a high potential for economic exploration in the Gurgueia Valley region, Piauí.

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Using Social Media to Debunk Covid-19 Myths

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***Abstract*—*Considering the COVID-19 pandemic, it is noteworthy to highlight a huge stream of misinformation and false treatment methods that emerged during this troubled period, in parallel with the need to obtain data quickly, a real race of publications of scientific works of dubious character and low scientific accuracy was started, being a major contributor to the giant wave of false information that can become as harmful as the infection itself. Two drugs that have gained notoriety in this period, Hydroxychloroquine and Ivermectin, both have studies developed or in development on their effectiveness, but there is still not enough evidence for the use of Ivermectin in a treatment protocol for COVID-19. Based on the data obtained through the form widely disseminated in social media, it was possible to reach 983 participants. Therefore, in the absence of studies and of a specific antiviral for the treatment of COVID-19, it is necessary for the doctor to make a decision, in agreement with the patient, to use the drug that best fits the condition presented, that is, to individualize the therapy and always think about the relationship between benefits and possible side effects. Moreover, it is essential to emphasize that non-pharmacological measures play a key role in preventing COVID-19, thus, their use should be more encouraged than the use of drugs that have no scientific proof in vivo in the treatment and prevention of this pathology.*

I. INTRODUCTION

In December 2019, a new disease emerged in the city of Wuhan, located in China. The respiratory syndrome is caused by a coronavirus, dubbed SARS-CoV-2, being the cause of the disease COVID-19 and the precursor to a pandemic. Various consequences of this global outbreak can be seen in many different spheres. Considering this whole picture, it is noteworthy to highlight a huge stream of misinformation and false treatment methods that emerged during this troubled period, in parallel with the need to obtain data quickly was started a real race of publications of scientific works of dubious character and low scientific accuracy being a major contributor to the giant wave of false information that can become as harmful as the infection itself (ALVAREZ et al., 2020).

SARS-CoV-2 in the initial phase does its viral replication mainly in the respiratory tract. It binds to the ACE2 receptor (angiotensin-converting enzyme 2) to

mediate its entry into the cell by endocytosis, and its entry is managed by a membrane protein called protein S. Chloroquine and hydroxychloroquine (CQ and HCQ respectively) could theoretically neutralize cell pH and prevent viral proliferation, and also have immunoregulatory activity by interfering with the inflammation process. However, no rigorous preclinical studies in cells or animals have been conducted to investigate these mechanisms or the efficacy of covid-19 treatment *in vivo*. In contrast, its adverse effects are very evident and the inappropriate use can cause from poisoning to death of patients (BIGUETTI; MARRELLI; BROTTO, 2020).

Ivermectin is an anti-parasitic agent that in recent years has demonstrated efficacy in tests against a mild species of virus, and has also shown anti-viral efficacy *in vitro*. This drug can inhibit the import of nuclear material and proteins from the host. Ivermectin is well tolerated *in vivo* by most patients, is mostly excreted in the feces, and has few lethal cases in humans. However, there are neurological adverse effects that can arise with its use and last up to seven days: confusion; tremors; convulsion; local swelling; vomiting. These results showed that there would be the possibility of Ivermectin having results against Covid-19, however, it is still necessary an extensive survey of data from *in vivo* tests, besides putting in the balance possible positive results versus adverse effects (MOLENTO, 2020).

The numerous treatments and prophylactic methods that have emerged in this period still lack more detailed studies on their clinical efficacy, in the absence of such research and of a specific anti-viral, it becomes, therefore, a doctor's decision, by the patient, to use the drug that best fits the presented picture, that is, individualizing the therapy and always thinking about the relationship of benefits and possible side effects (ALVAREZ et al.,2020).

II. METHODOLOGY

This is an exploratory, descriptive, and quantitative study, conducted online, which can reach people of different ages and genders.

An online form was developed using the Google Forms tool to obtain information from the population about some attitudes that were taken during the pandemic in the year 2020. It is important to note that no personal data was required to participate in this research, and it did not need to be approved by the Research Ethics Committee (Comitê de Ética e Pesquisa - CEPE, in Portuguese). In addition, the purpose of the research was informed on the form itself, as well as that the results obtained would be used exclusively for scientific purposes.

The form was prepared by the authors and advisor themselves and presents 14 objective questions addressing the use of Hydroxychloroquine and Ivermectin for treatment and/or prevention, as well as possible complications, whether or not they were prescribed, whether or not people know what the effectiveness of Hydroxychloroquine means only in *in vitro* studies, and whether or not they believe in the efficiency of the pharmacological and non-pharmacological measures that are employed in this period.

An immeasurable target audience was reached since it is an online form that could be widely disseminated in a territory without borders called the internet. It is worth mentioning that each author shared on their social media (WhatsApp, Instagram, Facebook) for three months (August, September, and October 2020) and it was possible for third parties to share it again and, thus, further increase the N sample enabling it to reach several states in Brazil and even outside Brazil.

III. RESULTS

Analyzing the form, a total of 983 participants were obtained and all questions were answered by them. When asked whether they had symptoms or were diagnosed with COVID-19, 31.1% answered yes, while 68.9% answered no. Regarding the use of Ivermectin, 51.3% denied using it, in contrast, 48.7% affirmed using it, subsequently, when asked if it was with a doctor's prescription and 23.1% affirmed that it was prescribed by a doctor.

As for the use of Hydroxychloroquine, 87.8% denied using it, while 12.2% affirmed using it. It was also asked if there was a prescription for this drug, 83.6% answered that they did not use it, 10.8% said it was prescribed, and 5.6% denied the prescription.

Furthermore, when asked about the purpose of using Ivermectin, 51% did not use it, 28.6% used it only for prevention, 7.8% used it only for treatment, and 1.5% used it for both prevention and treatment.

When asked if they felt any unwanted side effects from using Ivermectin, 50.8% did not use it, 44.6% denied any side effects, and 4.7% said they felt any unwanted side effects. When it came to unwanted side effects with the use of Hydroxychloroquine, 85.4% did not use it, 11.5% denied having felt any side effects, and 3.2% claimed to have felt side effects.

To characterize the participants' knowledge about the subject, they were asked if they knew what it meant for

Hydroxychloroquine to have its efficacy against COVID-19 demonstrated only in *in vitro* studies, with 59% answering yes, 29.8% answering no, and 11.8% answering maybe.

Concerning the use of Ivermectin, the participants were asked if they believed that this drug was what treated or prevented them against the disease, 53.3% answered no, 33.8% answered maybe and 12.9% answered yes. And when the same question was asked about Hydroxychloroquine, 65.7% said no, 25.3% said maybe, and 10% said yes.

On the other hand, it was also approached about the non-pharmacological measures in preventing COVID-19, the participants were asked if they thought that the use of masks, alcohol gel and hand washing are efficient in preventing COVID-19, 78.9% answered yes, 13.5% answered maybe, and 7.5% answered no. Finally, the participants were asked if they make frequent use of these non-pharmacological measures, 86.8% answered yes, 6% answered no, 6.2% answered once in a while, and 1% answered that they seldom adopt these measures.

IV. DISCUSSION

From these results, it is possible to see that the public reached was extremely significant, contributing to the research's greater relevance. Moreover, fortunately, most of the participants did not use these drugs, which is something positive because there is no scientific proof of efficacy *in* vivo both for the treatment and prevention of COVID-19.

It is important to note that within the sample space we obtained, those who made use of pharmacological measures opted mainly for Ivermectin for the purpose of prevention and treatment. It is worth noting that there is an *in vitro* study in which Ivermectin was shown to reduce 93% of the genetic material of the virus in 24 hours and a 99.8% reduction after 48 hours (MARRA et al., 2020). Despite the satisfactory results, this drug has not yet been tested in people with COVID-19 and we do not know if the dose allowed for use in humans is effective in treatment.

It should be noted that *in vitro* studies with promising results are not always effective in subsequent phases. This occurred with Ivermectin itself, which had shown an *in vitro* effect in inhibiting other viruses, such as Dengue, HIV, Influenza, and Zika viruses. However, in animal and human studies, the results were not satisfactory. A phase III clinical trial conducted in Thailand in 2014-2017 that evaluated the use of Ivermectin in the treatment of Dengue showed that the drug did not demonstrate any change in viremia or clinical benefit. In an animal model study, Ivermectin was found to be ineffective in preventing a lethal Zika virus infection. Clinical studies with scientific rigour are still needed to assess whether Ivermectin, independent of other confounders, has any benefit for the treatment of COVID-19 (MARRA et al., 2020).

In the survey, there was a small percentage (4.7%) that reported having presented some unwanted side effects due to the use of the drug. In general, the adverse reactions related to the use of Ivermectin are mild and transient, diarrhea, nausea, asthenia, abdominal pain, anorexia, constipation, vomiting, dizziness, drowsiness, dizziness, tremor, pruritus, rashes and urticaria may occur (MARRA et al., 2020).

With regard to Hydroxychloroquine (HCQ), it was observed that participants used it more for treatment, but there were also those who used it for prevention but to a lesser extent. A recent gold standard, randomized, double-blind, placebo-controlled trial in the United States and parts of Canada tested HCQ as post-exposure prophylaxis in 821 individuals. This trial reported that HCQ did not prevent COVID-19 compliant disease or confirmed infection when used as post-exposure prophylaxis within 4 days of exposure. The concept of using Chloroquine (CQ) / HCQ as prophylactic or therapeutic alternatives for SARS-Cov-2 infection is hypothetical at best, but its side effects are real. In fact, CQ / HCQ could contribute to the exacerbation of musculoskeletal diseases in elderly people at risk of developing severe COVID-19. Moreover, some of the characteristics of rheumatic patients at risk of developing CQ and HCQ-induced myopathies are advanced age and other notable underlying features (BIGUETTI; MARRELLI; BROTTO, 2020).

To further reinforce this, in two other studies published in the New England Journal of Medicine using Hydroxychloroquine as prevention in one study and as treatment in the other, there were also no positive results. The study that tested the efficacy of HCQ as prevention of COVID-19 was an open-label, randomized trial conducted in Spain using 2314 asymptomatic healthy contacts from 672 patients with a diagnosis confirmed via PCR (polymerase chain reaction), concluded that post-exposure therapy with HCQ did not prevent symptomatic SARS-Cov-2 infection in healthy people exposed to a PCR positive patient for COVID-19, it was also observed that the number of adverse effects reported was 56% in the group that used HCQ versus 5.9% in the control group (MITJÀ et al., 2020). In the other study testing the effect of HCQ in hospitalized patients with COVID-19, it is an

open-label, the randomized contralateral study selected 1561 patients to receive HCQ and 3155 as a control group, the results suggested that patients in the HCQ group were less likely to leave the hospital alive within 28 days than those in the control group (59.6% left alive in the HCQ group vs. 62.9% in the control group), and among patients who were not on mechanical ventilation, those belonging to the HCQ group went more often too invasive mechanical ventilation or even to death (30.7% in the HCQ group versus 26.9% in the control group), with this the study concluded that patients who used HCQ did not have a lower incidence of death within 28 days than the control group (HORBY et al., 2020).

Furthermore, it was possible to see in the research that, proportionally, the percentage of unwanted adverse effects in the use of each of these drugs, the one that presented a higher prevalence rate of adverse reactions was HCQ. There is abundant evidence of its very harmful side effects, and inappropriate prescribing can cause acute poisoning and even death. Due to their lysosomal affinity, CQ and HCQ accumulate in cells of various tissues with consequent tissue damage in liver, retinal, skeletal, and cardiac muscle cells. As announced by the FDA on April 7, 2020, HCQ side effects include irreversible cardiac effects (including cardiomyopathy and QT interval prolongation), proximal myopathy, and neuropathy (BIGUETTI; MARRELLI; BROTTO, 2020).

Results show that HCQ can efficiently inhibit SARS-CoV-2 infection *in vitro* (RANGEL et al., 2020). When analyzing the answers of the form, it can be seen that most (59%) know the meaning of the term *in vitro*, however, this did not prevent the use of drugs that showed efficacy only in this circumstance. In Brazil, a phase 2 clinical trial of COVID-19 sponsored by the state of Amazonas was suspended after 25% of patients developed prolongation of the QT interval (>500m/s) due to cardiotoxicity (BORBA et al., 2020). Therefore, the reflection regarding the indiscriminate use of these drugs is whether it is worth taking the risk of developing these adverse reactions that can sometimes be irreversible.

Despite scientific evidence showing that HCQ and Ivermectin are not recommended as a treatment and/or prophylaxis for COVID-19 due to lack of evidence proving their efficiency, 12.9% believe that Ivermectin was what treated or prevented against COVID-19 and 24.3% were in doubt. This doubt or even belief may be due to the dissemination of untrue information about the effectiveness of these drugs, causing many people to choose self-medication believing it to be the best alternative available at the moment.

The results regarding the effectiveness of the masks were contradictory, initially due to the lack of definition of the type of masks used in the studies: most use only the generic term “masks” or “face masks”. There was, however, a significant result for TNT face mask use and reduced risk of developing an influenza-like respiratory illness. The use of standard TNT face masks has been noted as an important barrier to droplet and aerosol dissemination in the face of COVID-19, even with its limitations of not having the filtration capacity for dental-medical-hospital environments (CAMARGO et al., 2020).

Another fundamental element to be considered, the use of a mask does not reduce or replace the need for the recommended hygiene measures, especially hand washing, and the maintenance of a distance of more than 1 (one) meter between people (CAMARGO et al.,2020).

Inevitably, hands become one of the main routes of contagion by touching contaminated surfaces and people and must be frequently sanitized to prevent the spread of the virus. Sanitization through constant and correct washing with soap and water and/or the use of alcohol-based disinfectants, specially ethanolic or isopropyl solutions, are the most recommended methods (SEQUINEL et al., 2020).

Regarding the non-pharmacological preventive measures for COVID-19 (use of masks, hand washing, use of alcohol gel or liquid), most of the participants (79.9%) believe in their preventive capacity. However, a portion of people (7.5%) do not believe in these prophylactic means and 13.5% are doubtful whether or not they work. The participants were also asked if they use them frequently, 86.6% said yes, 6% said no, 6.2% said they use them once in a while, and 1% rarely. Thus, it is noticeable that there are doubts about the subject that deserve to be clarified with scientific support and require more propagation than pharmacological measures since prevention is, without a doubt, the best alternative.

V. CONCLUSION

The research was of great relevance since it provided knowledge about the subject besides making unequivocal the importance of not self-medicating without consulting a doctor, since studies are absent and of a specific anti-viral for the treatment of COVID-19, thus it is essential to make a medical decision by the patient to obtain significant results in the treatment and prevention of symptoms caused by the virus. The study was concluded positively, the objectives were reached and the authors feel satisfied with the result because through the research an evaluation was made in favour of demystifying myths of a disease that is still being studied by scientists.

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An Application of African Prints to the Binding of School Notebooks

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***Keywords*— bookbinding, Africa print, school notebook.**

***Abstract*—** *Binding design is the most important process in the design of notebooks or school books, so good binding influences the student's choice and provides users with a social and cultural experience. Given that nowadays design is reinventing itself every day and becoming more and more creative we considered doing a study on the application of African prints in the binding of school notebooks, to carry out this study we did theoretical research and a practical essay that really edified us on the subject and demonstrate that the application of African prints to a multifaceted contribution starting from aesthetics for a new design. Based on the practice of design creation, this paper studies the uniqueness of African prints in notebook binding, analyzes the current situation of notebook binding in schools, and applies African prints in school exercise book binding, bringing unique charm to new visual taste.*

I. INTRODUCTION

In today's society, where science, technology and the economy are developing rapidly and continuously, the demand for new visual tastes is gradually becoming more and more diverse. In the education industry, more and more educators are paying attention to teaching culture and aesthetics. A student's first basic tool is his exercise book, which can record his school notes, and for a student, there is nothing more motivating than having a beautifully bound notebook, full of bright and joyful colors to record his school notes and ensure success at the end of the school year。

In general, many of us consider the school's notebook as just a simple tool for students, but this is wrong, and the school notebook represents a strong connection between the student's work and the teacher's work. (Buisson, 1911, s.p.)[1] A notebook is a collection of several pieces of paper that are assembled and sewn and used by students to write school notes and daily assignments given by their teachers. From this definition, we understand its usefulness in the daily lives of students. In fact because of daily use, the school notebook must have a very practical, beautiful and comfortable cover.

Therefore, the brightly colored cover will be surely appreciated with students when choosing a school's notebook. When we talk about brightly colored and very bright patterns, we think of African prints, sometimes represented in geometric shapes, where atypical flowers appeal to anyone seeking a new visual taste. After printing the paper and selecting the cover, the design of binding is the next step to follow。

Binding is the process of assembling and fixing pages that were previously written or printed inside the cover to prevent possible degradation and allow for sustainable use. It represents the completion of a document, and the more distinctive it is, the more it attracts attention and influences the student to choose his school notebook.

Based on the practice of design and creation, my research paper focuses on the applied study of African prints in school notebook binding, and in order to conduct this research, I have some special ideas that will be unfolded in the text.

II. THE BINDING STYLE OF THE NOTEBOOK

There are several types of notebook binding, depending on their purpose, whether professional, school, intensive, or occasional. The paper used to connect the printed paper, binding and cover reflects the final quality of the work, and the concept of quality means to deal with the actual document, visually aesthetically pleasing, comfortable to read and resistant to use. After the white paper is printed, the design of the cover is selected according to the type of binding to suit the type of final document。

1- Simple binding

Very convenient for documents with few page numbers, this binding is the most commonly used because it is efficient, economical, and easy to read for this type of reader to staple and attach to the cover page, making the document both sturdy and aesthetically pleasing.

This is designed for soft cover brochures, mailings, annual reports, business and technical manuals, plans and flyers, manuals, catalogs, newsletters. Here, the signatures are printed and folded, and then stacked on the collection device. The publication is then brought to the sewing head, and the staples are pushed over the spine. The collection device starts transferring the page to the saddle bar.

2- Perfect binding

Perfect binding is made from heavier cardboard printed patterns as the cover. It was launched in the 1920s to enable the mass production of magazines, catalogues and paperbacks. It is commonly used in paperbacks, graphic novels, literary journals, quarterly magazines, soft-cover children's books, poetry collections, autobiographies, and collections.

Its process is very simple, the folded pages are stacked in the order of the pages, and the sides of the spine are cut to get rid of the folded edges and make it rougher. Then along the way.

3- Wire-o binding

This binding method is called punching and binding style binding. In this technique, a hole or perforation is drilled or perforated along one side of the printed page, and a wire is moved through the hole. Verystrong binding, it facilitates 360 degree opening of the manual, with comfortable handlingand good reading. It is highly appreciated for its utility asset, which facilitates the updating of documents by deleting and adding worksheets without damaging them. Suitable for presentations, essays, reports, employee handbooks, training manuals, recipes, student diaries, educational programs.

Simple leaves are stacked on top of each other and the pores are evenly distributed to form a flexible spine. Wire loops or plastic coils (spirals) are then placed in the holes to create the trunk of the document。

4- Sewn binding

This super-strong binding is the standard for luxury books and books. It gives the book exceptional quality, durability and extreme stability. Since rigid pages are called covers, sheets are placed together and sewn onto the cover, and at the end of binding, the back of the manual will be square or round for more elegance. Used in public library editions, collector's editions, art books。

Here, signatures will be assembled and sewn individually along the folds, the book cover is connected with a threaded book block, and finally the folds along the glue are applied to seal the spine. These threads are sewn on each page before being tied once. All in all, the binding method chosen usually depends on the size and thickness of the document, its use, and its cost, as multiple designs exist。

III. THE UNIQUENESS OF AFRICAN PRINTS IN NOTEBOOK BINDING

Fabrics with vibrant colors and patterns that differ from each other are now an integral part of the design of new visual tastes. It has been applied to many everyday objects, without forgetting the accessories of daily life that we all have, our allies can write our elementary school notes, personal agendas or our office notes, i.e. notebooks. Regardless of its use, we have at least one in our business. Due to its graphics and very colorful patterns, African fabrics represent diversity, while expressing a great deal of cultural influence due to their original and unique designs. Its application on notebooks will give notebooks very distinctive characteristics。

1- Originality

The concept of originality that complements creativity is the ability to generate valuable ideas in a given environment. In everyday life, many people are particularly interested in visual language.。 (Edwards, Betty 1986) [2]And novelty. Therefore, in order to create an original concept of binding, we considered applying African prints in the binding of school notebooks, since the African prints part was appreciated by all those who found them. And it should be noted that the application of African prints is handmade, which brings a certain sense of modernity, creativity and trends to school notebooks, which will surely please school-age children.

2- Aesthetic

First of all, the aesthetics associated with beauty are one of the characteristics of African prints, and it is applied

to the binding of school notebooks, directly giving notebooks this feature. With thehighly embellished production methods and carefully arranged choice of bright colors, the application of African prints in notebook binding gives our notebooks a clear aesthetic. It should be noted that during the production process, the shape and binding of the notebook are very careful to obtain the final beautiful object. In short, when the notebook itself is beautiful, it is perfect for attracting students' enthusiasm and good note-taking, so a personalized notebook with African prints and elaborate finishes will be proudly presented by those who own it.

3- Protection and Comfort

The comfort of African prints figures in binding a school notebook is undoubtedly the most essential, because taking notes, writing and even drawing requires a practical notebook that is easy to open and read. To meet this need for comfort, we have mastered several techniques. Having said that, we opted for a staple with a cardboard lid covered with An African print, which subsequently brought a spectacular effect and hardened the lid, making the student more comfortable and resisting many of the students' daily manipulations of the notebook.

4- New Design

Nowadays, the new design is characterized by the use of bright colors and any other possible image representations on the cover of the notebook, which proves that the creative field is constantly reinventing itself every day. Usually in the school supplies market we come across notebooks with various covers, so everyone can find his account. Given that design reinvents itself every day, we believe that applying African prints to notebook binding can be considered a new design because it is hardly found in the market and is little known. Printing in bright colors and inserting them into notebook binding will undoubtedly give birth to a new visual taste and awaken students to be more creative.

IV. ANALYSIS OF THE CURRENT SITUATION OF SCHOOL NOTEBOOK BINDING

The use of notebooks will be disseminated by the academy established in the sixteenth century, (Albertini, 1986) [3] (Flamarion 1997) [4]. For students in small schools, the object notebook is first mentioned in the code of Catholic school life founded (Jean-Baptiste de La Salle) [5] at the end of the seventeenth century. Every elementary school student who wants to learn to write must ask his parents to buy his paper folded into four and sewn over the entire height. To avoid wasting students efforts to master good writing, high-quality notebooks are needed. The paper should be neither too thick not too thin, but blank, simple, stitched and glued on everything.

In the years that followed, states planned or ordered uniform compilation of school notebooks. The main purpose is to build a comprehensive learning system, innovate and practice various disciplines, and emphasize humanistic characteristics. Previously, school notebooks were only made by folding paper into two, four, or eight sheets of paper, but at present, the design of most school notebooks is fairly uniform. Model color and cover binding became increasingly practical, but very fancifulor no customization**,** so after the school curriculum, few students kept notebooks to consult them during the senior year. At the same time, there are also certain aesthetic and artistic traces on the finishes of some school notebooks today.

In Taiwan, for example, in 2013, a textbook reform campaign launched by a group of young people attracted worldwide attention. They reorganized and integrated the cover and design of the school notebook and combined aesthetic features to form a logical layout. At the same time, interactive design has also been added to the cover of the notebook to allow students to better understand practicality and cultivate their own sense of beauty.

Through a large number of literature and research, we found that the design of the notebook binding in other countries adopts different expressions, and at the same time, thanks to the integration of cover design, sometimes with cultural beauty, students also have a sense of beauty. For example, in some African countries, such as France and Cameroon, the design of school notebook binding includes the design and placement of different contents and education with cultural contributions, while integrating aesthetic thinking into students' daily learning life. Due to the different bright colors, educational images, sometimes multiplication tables and mathematical or scientific data are part of the layout. In fact, there is no difference between the design of school notebooks and the understanding of the concept of beauty between China and foreign countries, but foreign countries will begin to educate and cultivate beauty. Another example is in France, for them, people should not dress simply, but should dress appropriately. Aesthetic education occupies a very important position in the belief that there is no education without aesthetic education, and a new innovative form of school-based notebook can also make it easier for students to accept and understand the spread of beauty, so as to achieve an overall improvement in the level of education. (Sukhomlinski) [6]。

Therefore, we believe that it is necessary to consider redesigning the binding of school notebooks by applying

African fabrics, which can have an impact on the development of people's knowledge of the outside world, including beauty, thought, quality, in another sense。

V. CLASSIFICATION AND CHARACTERISTICS OF AFRICAN PRINTS

Depending on the different countries of the African continent, we have observed that there is a fabric with a typical print. These fabrics have different patterns, craftsmanship and weaving from each other. For decades, African women have used their imagination and creativity to produce a wide variety of African prints, and today African prints bring a new touch of beauty and originality to design. This broad pattern has multiple features, some of which we have chosen to present。

1- Colors

What would African prints look like without colors? Bright colors are the other side of African print on an artistic, conceptual and technical level. Color is an integral element of African prints, as some shades are unique and cannot be found elsewhere. It's clear to us that the color we perceive affects our emotions, our behavior, and our perception of things and the idea of this fact selection tool depends on how we perceive it when we look at it. African prints consist of colors such as white, yellow, green, indigo, red, etc. Each color has a connotation, depending on the country and region to consider when choosing and using colors**.**

2- Geometric Shapes

Geometric shapes are usually graphics that represent the shapes of different objects commonly used in mathematics, such as linear, granular, granular, square or triangular, curved or blurred circular lines, and spiral shapes. Speaking of the geometric shapes that make up African prints, some seem to come from the spirit of mathematicians, while others combine geometric shapes and poetic paintings. In addition to visual appeal, originality, and aesthetic style, its geometric patterns are sometimes attributed to deep meanings, such as curved landscape patterns and some triangular structures depicting the change of the shape of the moon according to the period. In short, the originality of his motif creators is infinite.

3- Symbols

African prints are characterized by philosophical and sometimes historical symbols full of meaning, and they are characterized by symbols that can be objects or images, written texts, organic or specific brand symbols, visual expressions conveying knowledge, feelings and values. For African engraving, symbols, sometimes shortcuts to convey deep truths in visual form, are of global importance and are found today in logos, clothing, furniture, sculptures, pottery pots and many other everyday tools.

VI. DESIGN AND APPLICATION OF AFRICAN PRINTS ACCORDING TO THE NATIONAL CHARACTERISTICS OF SCHOOL NOTEBOOKS

As an indispensable tool in students' school life, school notebooks must follow different corresponding principles in their design. Different subjects have different needs that must be taken into account. Therefore, the design must pay attention to the method of designing the school notebook. Because school notebooks have their own unique characteristics, we need to rethink how to design the binding of school notebooks to achieve practical tools and a high level of comfort, as well as to play a role in aesthetic diffusion. When designing school notebooks, it is necessary not only to meet the aesthetic and functional requirements of school notebooks, but also to optimize and improve the intake and preservation of school works in various disciplines.

First, we need to pay special attention to the binding design according to each material and the number of pages required for the notebook。

Secondly, the finishing and forming characteristics must have a clean appearance, with the lid and edges of the plate having a sharp appearance and strict square. Not to mention the effective, carefully crafted seams or stitches with clean edges. In short, in today's artistic environment, people's concepts in various fields are progressing, which promotes aesthetics, and the requirements for art and design are at a higher level of development.

It is particularly important to address the challenges and progress made in textbook compilations, particularly with regard to school notebooks. We can see that in creating the framework of textbooks and the design of textbook notebooks taught by the field of study, it is necessary to follow its inherent essence and philosophy, so that our innovative progress is more based on the law, and mastering its guiding principles will make us more efficient in improving and creativity.

VII. CONCLUSION

In an educational setting, the school notebook is one of the first tools that students are exposed to in their learning, and its importance can be imagined. Therefore, in order to protect the school works well, it is necessary to

consider the binding part of these notebooks, summarize the different types and characteristics of the binding design, and observe the current binding situation of the school exercise book, we believe that it is necessary to create a new design of the school notebook, so the subject was studied. : An application of African print on the binding of notebooks in schools. Through the summary of this paper, the theoretical and practical results of this research can be summarized into the following aspects: the uniqueness of African prints in notebook binding, the analysis of the current situation of school notebook binding, and the application of African prints in school notebook binding. After studying its various aspects, it was noted that the application of African prints to school notebook binding was certainly a kind of creativity that would lead to new visual tastes, but there were still many theoretical and practical design structures worth considering, depending on the national characteristics of school notebooks.

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An Introductory Analysis About the Conception of Death in Schopenhauer[1]

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***Keywords*— Death, Will to Live, Philosophy, Schopenhauer.**

Abstract*—This article aims to explain, in a propaedeutic way, the fundamentals about the conception of death in Schopenhauer. Thus, it is dedicated to the book The World as Will and Representation (1966), precisely in these manuscripts: The World as Will, First Aspect: The Objectification of the Will and On Death and Its Relation to the Indestructibility of Our Inner Nature. Hence, this research adopts the following methodological plan: initially it exposes the concept of will and representation regarding the phenomenon of death which throughout philosophical tradition proves to be one of the earliest man's metaphysical anguishes. Subsequently it displays the author's philosophical argumentation in relation to the phenomenon of death that is relevant for understanding all Schopenhauerian philosophy. Schopenhauer (1966) demonstrates this fact, in the discourse about death, as something inherent to man's phenomenal existence that is a manifestation of the will to live.*

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I. INTRODUCTION

This article aims to clarify, through a propaedeutic way, some of fundamentals on the conception of death in Arthur Schopenhauer's view. Therefore, it adopts as a basis the texts *On Death and Its Relation to the Indestructibility of Our Inner Nature*and *The World as Will, First Aspect*: *The Objectification of the Will* both from *The World as Will and Representation.* Accordingly, it seeks to understand the role of death and of the dying process as the main ways of human predisposition for philosophical reflection on the meaning of life.

Thereby, throughout the text a following theoretical and methodological plan is adopted: at the beginning it shows a brief approach about the concept of will from the book *The World as Will and Representation* (1966), since, the world is beyond sensible as well as the will is a force that moves bodies in this world; hence, this notion interacts with the philosophical conception of death in Schopenhauer, especially, when it exhibits the will as a force which acts in relation to the phenomenon of death.

The introduction of the paper should explain the nature of the problem, previous work, purpose, and the

contribution of the paper. The contents of each section may be provided to understand easily about the paper.

II. BRIEFS CONSIDERATIONS ON THE WORLD AS WILL AND REPRESENTATION

The research discusses, in this topic, important concepts for the understanding of Schopenhauerian philosophy, namely, will and representation. These terms are in one of Arthur Schopenhauer's main works that is under the title of *The World as Will and Representation* (1966) in which he presents the following philosophical proposition: the world just as it is would be a duality that presents itself as will and representation. As a representation the world would be of visible things, of forms, and of matter that is continuously in motion; the other world as a will would be the inner force that moves and transforms others. According to Torres Filho (2005), Schopenhauer himself makes clearest this idea considering the point of view that the world as representation has two essential, necessary, and inseparable halves. One half is the object; its forms are space and time for this reason the plurality. The other half is the subject; it is not placed in time and space because it exists, as entire and indivisible, in every being who perceives it. Consequently, just one of these beings with the object completes the world as representation just perfectly as the millions of similar human beings that exist; However, if this being disappears, the world as representation does not exist anymore.

Specifically in *The World as Will, First Aspect: The Objectification* of the Will which is the second book of *The World as Will and Representation*, the link between philosophy and natural science is explicit, first, as it justifies the sensible things in cause and effect relationship which depends on space and time to happen; second, as these things submit themselves to the inner force that exists in all being, to will, to our inner essence, and to natural law in addition to all law of causality.

Besides this holistic view on man and his space, Schopenhauer (1966) also presents the metaphysical dimension of things inner essence through the concept of will which is perceptible, mainly, when the author brings to light the life cycle dimension and the cosmic interconnection that is a result of the natural force which moves and exists in all beings. Accordingly, Torres Filho (2005) says the starting point of Schopenhauer's thought is in Kantian philosophy who set the distinction between phenomenon and thing in itself that he named *noumenon*. In other words, what appears to us and what exists in itself. The thing-in-itself or *noumenon* could not be an object of scientific knowledge, conforming to Kant, as classical metaphysics intended until that moment. In order that the science would be restricted to the world of phenomena and constructed by the categories of understanding as by the forms of sensibility (space and time). Schopenhauer concludes, from these distinctions, that the world would be nothing any more than representations which the author understands as the synthesis between subjective and objective as well as between external reality and human consciousness.

In this regard, the philosopher under consideration expresses the human being through reason has the certainty about does not know the elements around, but he just feels them using his sense; as " an eye that sees a sun, a hand that feels an earth", the world around exists by the representation that personifies all over, considering the relation with who perceives it. Schopenhauer (1966) reveals that appearances make the reality.

According to the previous reasoning, the things that exist and are perceptible are forms of matter in eternal permanence which is called phenomenon, what the sense organs can perceive and be affected; since, the content of all organic matter in the human body is in constant motion and changing from one state to another, as in an eternal cycle that always tends to happen. On the phenomenon of death and the changes of matter, Schopenhauer (1966) ponders that the concepts of disappearance and permanence cannot apply themselves to our true essence or to the thing-in-itself that is in our phenomenon. It occurs once they are taken from time which is simply the form of the phenomenon. It is possible, nonetheless, only imagine the indestructibility of that core of our phenomenon as the permanence of its own and, considering the scheme of matter, also as a permanence that persists in time under all alterations of forms.

Then, the philosopher expresses that the human being, through reason, obtains the certainty of not knowing the elements around him; he only has sensations of the forms that exist. We know that this phenomenal existence is the representation of the relationship between will and its objectification. In this case, Torres Filho (2005) notes that science would restrict itself to the world of phenomena. The forms of sensibility and the categories of understanding would constitute science. Therefore, Schopenhauer affirms, according to Torres, that the world would be no more than representations which he sees as a synthesis between subjective and objective as between external reality and human consciousness.

The concept of will that Arthur Schopenhauer proposes is important to the metaphysics of nature, specifically in the work *The World as Will and Representation* (1966). The author manifests will in the

thing-in-itself[2] and in the essence of the vital force such as a wanting to live that is not only about the man but also extends to all beings in general. In Schopenhauer's (1966, 138-140) words:

> It is the innermost essence, the kernel, of every particular thing and also of the whole. It appears in every blindly acting force of nature, and also in the deliberate conduct of man, and the great difference between the two concerns only the degree of the manifestation, not the inner nature of what is manifested. [...] The will as thing-in-itself is quite different from its phenomenon, and is entirely free from all the forms of the phenomenon into which it first passes when it appears, and which therefore concern only its objectivity, and are foreign to the will itself.

It understands that will also involves the meaning of thing-in-itself that Plato recognizes as eternal ideas or immutable forms and which Kant emphasizes in the phenomenal relation of effect to cause. The objectivity of will in relation to the phenomenon of death is in the maintaining of vital force that keeps the existence. The Will also involves the meaning of thing-in-itself that Plato recognizes as eternal ideas or immutable forms and which Kant emphasizes in the phenomenal relation of effect to cause. The objectivity of will in relation to the phenomenon of death is in the maintaining of vital force that keeps the existence. Schopenhauer, reflecting on the inner essence governing each *anima*, concludes that in the inner of being there is a force animating, moving, and giving impulse to bodies, externally and internally, which we call Will. (SCHOPENHAUER, 1966).

Regarding to this, the access to phenomenon is the representation of the objectification of the will that acts in all beings; since, it is not from the outside that one must arrive at the essence of things, this is an unsuccessful searching that finds only ghosts or formulas; as a man who goes around a castle looking in vain for an entrance, and sometimes drawing the façades. The author uses this metaphor as an example of the illusion that physical forms can capture. (SCHOPENHAUER, 1966)

The example that Schopenhauer (1966) gives about the act of drawing a façade in an attempt of reaching reality is the opposite of searching for real knowledge, as it is only possible achieving through an understanding beyond the surface of things that is not merely on visible things or accessible for the subject who knows. In fact, it is necessary an inner knowledge about phenomena to understanding the duality of beings in general.

For Schopenhauer (1966), the key to all human existence is in the recognition of this relationship between will and representation and the inner force with its visible manifestation present in the body, thus:

> He would then also call the inner, to him incomprehensible, nature of those manifestations and actions of his body a force, a quality, or a character, just as he pleased, but he would have no further insight into it. All this, however, is not the case; on the contrary, the answer to the riddle is given to the subject of knowledge appearing as individual, and this answer is given in the word Will. This and this alone gives him the key to his own phenomenon, reveals to him the significance and shows him the inner mechanism of his being, his actions, his movements (SCHOPENHAUER, 1966, p. 128).

Every voluntary movement that the body produces comprising animal functions is the phenomenon of an act of will, in other words, a representation of the whole that organizes animal life in its development and unfolding of the species. This is nothing more than a phenomenon of will manifestation.

> Sensibility, nerves, brain, just like other parts of the organic being, are only an expression of the will at this grade of its objectivity; hence the representation that arises through them is also destined to serve the will as a means (μηχανή) for the attainment of its now complicated (πολυτελέστερα) ends, for the maintenance of a being with many different needs. (SCHOPENHAUER, 1966, p. 202)

In its most complex definition, we can consider will as "the innermost essence, the kernel, of every particular thing and also of the whole. It appears in every blindly acting force of nature" (SCHOPENHAUER, 1966, 138). The will extends to the individual represented in the species that organizes the biological complexity of the phenomenal existence which acts independently of all

[2] This term is an appropriation of Kant's doctrine as a result of the conceptual approach between both authors. The thing-in-itself is nothing more than representation, it only exists in relation to the phenomenon according to Schopenhauer's immanent philosophy. The author's greatest concern, however, is not explaining the thing-in-itself, but determining that the will to live is in this; on the other hand, the phenomenon only exists in relation to the thing-in-itself. Another important point for Kant is the knowledge of the world that is perceived by the senses and behind that would be the thing-in-itself which is the true essence.

forms of phenomenon. Regardless of any action of bodies, there is always the will.

> For the individual finds his body as an object among objects, to all of which it has many different relations and connexions according to the principle of sufficient reason. Hence a consideration of these always leads back, by a shorter or longer path, to his body, and thus to his will. (SCHOPENHAUER, 1966, p. 176-177).

The phenomena that occur are independent of time and space as they are a manifestation of will in the hybrid duality as will and representation. For example, with the phenomenon that happens when a hair comes off the body, it is perceptible to the senses when it falls on the floor that rests and it is moved by a force independent of the time it takes to fall and space. However, the will always exists, whether in the form of the growth or renewal of the hair fiber resulted from this entire infinite cycle and remaining independent of the circumstances of time and space as it is an action of the will. Therefore, the will as a thing-in-itself that is different and independent from the phenomenon is only objectified in the manifestations of the body as the “inner essence of any striving and operating force in nature” (SCHOPENHAUER, 1966, p. 139).

Considering the aspects of previous discussions, it is clear that modern sciences largely influenced Arthur Schopenhauer's ideas such as Charles Darwin's theories about the study of species, the knowledge of the world reality associated with natural sciences, and biological thought. We can compare the basic principles of Charles Darwin's ideas with some propositions of Schopenhauer's philosophy, especially when it gives attention to the reproduction of species and the maintenance of life through the renewal of beings as a consequence of a cycle. In this cycle, the importance of whole, which is the continuity of lives through species, overlaps the individual.

Another starting point for Schopenhauer's thought is the Kantian philosophy. Immanuel Kant's[3] philosophy, indeed, faced two important sciences for that time: mathematics and physics. The two sciences became a path for those who wanted to know the absolute and universal systems as well as the natural phenomena. Next to the development of these empirical sciences were the metaphysical theories. In Germany Kant excelled, according to him the problems on possible ways of knowing the world were important. This idea relates to physical phenomena because it is linked to the knowledge of forms in the natural phenomena.

Kant distinguishes two ways of knowing the world: *a priori*, the pure knowledge that does not depend on any experience; *posteriori*, the knowledge that sensible experiences provide. Yet on the Kantian critique of two forms of sensibility that come close to physical phenomena yet: time and space, as conditions of things that we can know. They are independent of experience that are *a priori* knowledge and earlier to experience; however, nothing is known outside this relationship.

From this perspective, the natural sciences have a close relationship with the immanent metaphysics proper to Schopenhauer when he relates the understanding of the world together with its physical phenomena which the existence depends on forms, space, and time. About this, Kant adds: "I shall here take account of natural science only insofar as it is founded on empirical principles" (KANT, 1996, p. 18). Then:

> When approaching nature, reason must hold in one hand its principles, in terms of which alone concordant appearances can count as laws, and in the other hand the experiment that it has devised in terms of those principles. Thus reason must indeed approach nature in order to be instructed by it; yet it must do so not in the capacity of a pupil who lets the teacher tell him whatever the teacher wants, but in the capacity of an appointed judge who compels the witnesses to answer the questions that he puts to them. (KANT, 1996, p. 19).

On the other hand, metaphysics opposes ready-made laws and knowledge that are simple classifications. The metaphysics “rises entirely above being instructed by experience” (KANT, 1996, p. 20). It arrives at the conclusion that science only knows the world superficially, in the order of phenomena, which is also the limit of its knowledge.

Metaphysics needs natural phenomena to recognizing, nonetheless, what is behind every movement of bodies. The Philosophy of Nature seeks its bases in a science that knows objects *a priori*, as they are independent of experience in order to appropriate the inner forces that move and transform these others.

[3] The Kantian principle that Schopenhauer refers to is the *transcendental Idealism* that is a form of idealism which recognizes knowledge through the senses. Kant develops this notion in the *Critique of Pure Reason* that considers the sensible world where all knowledge is restricted as mere forms that appear to the subject who knows, in other words, an appearance [representation], determined by the forms of sensibility and our intellect; what appears, however the-thing-in-itself, outside this relationship with the subject would remain completely unknown (SCHOPENHAUER, 2017).

In view of the phenomenal relationship between body and will that the author's metaphysics of nature expresses, there is also a deep connection between Schopenhauer's philosophy and the discourse of the natural sciences that study life in its physical and phenomenal aspect. In the broad field of the natural sciences and their numerous ramifications, morphology is revealed as a science that describes the forms and the etiology that observes the changes in these forms. The first analyzes fixed forms and the second considers matter in motion, according to the laws of nature and the passage from one form to another. (SCHOPENHAUER, 1966).

Also, about the study of fixed forms, botany and zoology, in which the different forms are classified in an immutably way, despite all changes, these forms remain fixed in their classification of species. Then, we can classify every biological world in natural and artificial systems and calculate them in the form of concepts capable of defining life from the part to the whole (SCHOPENHAUER, 1966).

Etiology and natural sciences, that study the cause and effect relationships, are responsible for the changes in these forms in which others conditionate the states of matter. In that order, the laws of physics, mechanics, chemistry, and physiology are conditioned. We recognize the phenomena in these laws of causes and effects which are produced in space and time.

Natural sciences correspond to the entire content of the phenomenon, which the law of causality generates, depending on experience. We can see and feel it only in its representation, but the inner essence, the " force itself that is manifested, the inner nature of the phenomena that appear in accordance with those laws, remain for it an eternal secret, something entirely strange and unknown, in the case of the simplest as well as of the most complicated phenomenon." (SCHOPENHAUER, 1966, p.125).

The laws of cause and effect linked to phenomena are in the field of sensible experience that is capable of producing content for phenomenal forms of existence. As for the unknown inner essence remains to the natural sciences, since, "the inner nature of the forces that thus appear was always bound to be left unexplained by etiology, which had to stop at the phenomenon and its arrangement, since the law followed by etiology does not go beyond this" (SCHOPENHAUER, 1966, p. 126)

> We must also not conceal the fact that what the sciences consider in things is essentially nothing more than all this, namely their relations, the connexions of time and space, the causes of natural changes, the comparison of forms, the motives of events, and thus merely relations. (SCHOPENHAUER, 1966, p. 203).

The etiological sciences only present the phenomena that appear as representations, their primordial chaining is going to be only the laws and the respective order of their production in time and space. But it does not teach us about the inner essence of the phenomena themselves as on the thing-in-itself. "Moreover, the law of causality has validity only for representations (SCHOPENHAUER, 1966, p. 126).

Therefore, the individual who knows his relationship with the body also knows this in two ways: through representation in phenomenal knowledge and in the will, because "every true act of his will is also at once and inevitably a movement of his body (SCHOPENHAUER, 1966, p. 128)". It is in the body that the will finds shelter for its objectification, it does not apprehend any act of will dissociated from bodily movement, nor from the representation of perceptible bodily phenomena such as hunger and the process of dying.

The body is the immediate object and the will is the *a priori* knowledge of the body; the body is the *a posteriori* knowledge of the will. Every effective act of the will is directly a phenomenal act of the body; and, in contrast, every action performed on the body is immediately an act performed on the will: as such, "it is called pain when it is contrary to the will" (SCHOPENHAUER, 1966, p. 129). As Cacciola states (2007), the recognition of the body as an essential mark of the individual and of their actions as expressing acts of will makes unhappiness and suffering facilitates the path to death although the pleasure and happiness complicates it. The struggle between opposing impulses manifests itself in the body as an immediate phenomenon of the will which instead of being closed in itself, is split. This will, therefore, as the source of a struggle at all levels of nature from matter inert (such as the struggle between weight and resistance) until the man and his two opposite impulses (conservation and himself destruction).

In this case, death is an action that exerts on the body causing pain and suffering, "every stronger or heterogeneous affection of these sense-organs is painful, in other words, is against the will; hence they too belong to its objectivity" (SCHOPENHAUER, 1966, p. 129). The identity of the body and the will manifests itself in the fact that any violent and exaggerated movement of the will, namely, any affection immediately agitating the body and the entire interior organism disturbs the course of vital functions. This considers the body being the condition of knowledge of the will as a thing-in-itself. As Schopenhauer (1966) emphasizes: as other parts of the

organic being, nerves, brain, and sensibility are expressions of will. Then, the representation arising through them has as destiny serving the will as means for achieving it.

Pain or pleasure is an immediate affection of wanting; and the subject's manifestation of wanting conditionate the will. The body and the will are one; what we call representation we also call will, while we are aware of this, we know the totality of the individual and what affects him. When we reflect on the essence of bodily activity, soon, we will arrive at the essence that could not be felt without its pure and visible manifestation through the body.

Schopenhauer (1966) proposes the doubt stating that there is no way to think about anything outside will and representation. Thus, we call will the body outside the representation; moreover, the essence in itself of any phenomenal form and the representation would have no force without the action of the will. The will manifests itself in the voluntary movements of the body, insofar as they are only visible acts of will in the form of phenomena; the will, this continuous essence that rules over beings in general even the inanimate and irrational beings. This force is also irrational and spontaneously it is an unique desire.

It assumes this invisible force acts as a guide of animals in nature being pure extinction of survival, or rather, will to live. In *Metaphysics of love* the author marks love as the pure will of perpetuating species and desire for procreation, through reproduction that is the choice of a merely selective partner, according to the characteristics that best represent the traits for giving rise to a new being of the healthiest and strongest species possible. Procreation and death as objects of the will are one of the ways to perpetuate species as acts of will objectified in the body. About this Schopenhauer (1966, p. 1034) expresses:

> [...] birth is an arising out of nothing, and accordingly that its death is an absolute annihilation, and this with the further addition that man has also come into existence out of nothing, yet has an individual and endless future existence, and that indeed with consciousness, whereas the dog, the ape, and the elephant are annihilated by death-is really something against which the sound mind must revolt, and must declare to be absurd.

However, the body is a representation, and all that we can perceive are the phenomena and the body being "an object among objects" (1966, p. 127). The part that death affects is only the body while the will remains intact in the perpetuation of the species and the origin of new life through the process of putrefaction and reintegration of the body into the life cycle, this, without doubt, affects us generating repulsion and fear, since:

> For the individual finds his body as an object among objects, to all of which it has many different relations and connexions according to the principle of sufficient reason. Hence a consideration of these always leads back, by a shorter or longer path, to his body, and thus to his will. (SCHOPENHAUER, 1966, 202).

On the other hand, Schopenhauer seeks an interpretation of the world beyond the senses that means beyond the sensible world; and, he finds in the body the foundation of the subject-object relationship which is what we note in the book *The World as Will and Representation*. It is in the body that all "will-to-live" is objectified and manifested as a phenomenon of the world accessible to our senses.

III. DEATH: "MUSAGETES OF PHILOSOPHY"

This topic addresses the issue of man and the certainty of death, then the conceptions that mitigate the insurmountable truth of the dying process articulated to the understanding of how man reflects on this process of reintegration into the life cycle. It demonstrates, at the same time, how we can consider this phenomenon as one of the metaphysical anxieties that accompany human existence along with the condition for philosophizing. Thereupon, Schopenhauer begins his essay on death stating that it is the inspirational genius of philosophy. According to him, "without death there would hardly have been any philosophizing" (SCHOPENHAUER, 1966, p. 1021).

The author's thought approaches Eastern religions through the holistic understanding of reality and the integration of man into a universal cosmic order that interconnects bodies in an endless life cycle. One of the purposes of religions and philosophy, says Schopenhauer, is making man faces the death with serenity. From this point, he analyzes Indian beliefs, Brahmanism and Buddhism, that address this issue: the author finds the path in religions Eastern for man, over the course of his life, seeing himself as a primordial being who is independent of any birth or death.

This thought for Schopenhauer is much more effective than other beliefs that other religions launch in which the being is born from nothing and obtains another being own existence (these teachings would make people unable to assimilate in the future more correct and solid concepts).Hence, Schopenhauer (1966, p.1021 -

1022) affirms that "we find in India a confidence and a contempt for death of which we in Europe have no conception".

The issue of death that the philosopher addresses, accordingly, will find other issues beyond the observation of nature and the preservation of the human species. Otherwise, the ethical[4] aspect with regard to the fear of death that is the attitude of man in face of the apparent finitude of himself and the other conducts the philosophical discourse. Schopenhauer discusses man's anguish when he learns that he is going to die and not only for his own death, but also for the death of the other, out of compassion. As man's first contact with the phenomenon of death is through the death of others.

As the research discussed earlier, man is the only being who knows he is going to die and as an antidote to this evil he creates consolations to mitigating this truth. He fears death, yet, as something that will end his phenomenal existence and all his memories whether good or bad. When a life finds its end in the circle of nature, all the stories, dreams and other facts created by the intellect are also lost. Nonetheless, this can generate fear, the fear of losing the individuality of the self in the immensity of the plurality of the species.

Every living being carries the fear of death, the *fuga mortis* (escape from death) inherent in nature and in blind will. The organism that is going to disappear with death will be reintegrated into the soil from which it came, and this is the very will walking through the phenomenal world. This is the will itself walking through the phenomenal world. The organism will be extinguished with death, but things will always be in the same place, there will always be men, plants, and the will that keeps these things exactly where they are. Jean Lefranc (2007) on these issues argues that the fear of death can come not from reason or knowledge, but, in fact, this fear is unfounded. Clinging to life is neither rational nor the result of reasoning: it, which is animated by a blind desire, arises from the depths of our being. In other words, it is the immortal part of our being that makes death fearful and it is the mortal who does not really fear it.

The fear of death is unfounded because the annihilation of the body will not disappear with the life-giving essence. As it shown previously, there is nothing to fear since the individual with death will not be led to nothing, in contrast, he will find shelter inside the nature[5]. We cannot see the death, however feared it may be, as an evil, it often comes to seem like a good thing, an expected friend, if we think about those who throughout their lives and encountered insurmountable obstacles such as incurable diseases or who suffer from a profound sadness, having as a refuge this concept of returning to nature[6], although few have these pre-established ideas (SCHOPENHAUER, 1966).

Throughout the texts on the *Metaphysics of Death* Schopenhauer talks about the fear of death and compassion for the death of the other. The fear of death in this case is related to the metaphysics of the will, it is through the will to live that the fear of the annihilation of the body is caused by the unconscious will to live. It reaffirms the will to live materializes itself in the body. There is no doubt that the will to live, being blind and irrational as approaches death, fears the annihilation of the individual superimposed on the entire species. On the other hand, reason realizes that the death of an individual is not exactly the death of the species and, in a rational way, Schopenhauer (1966, p. 1036 - 1037) clarifies:

> Know your own inner being, precisely that which is so filled with the thirst for existence; recognize it once more in the inner, mysterious, sprouting force of the tree. This force is always one and the same in all the generations of leaves, and it remains untouched by arising and passing away. […] Therefore, what forces itself on us more irresistibly than the thought that that arising and passing away do not concern the real essence of things, but that this remains untouched by them, hence is imperishable, consequently that each and

[4]Schopenhauer's (1966, p. 1022) ethics of compassion towards death addresses that: "Here we have primarily before us the undeniable fact that, according to natural consciousness, man not only fears death for his own person more than anything else, but also weeps violently over the death of his friends and relations. It is evident, indeed, that he does this not egoistically over his own loss, but out of sympathy for the great misfortune that has befallen them. He therefore censures as hard-hearted and unfeeling those who in such a case do not weep and show no grief."

[5] According to Schopenhauer (2020) the duration can be ensured to humanity, and not to individualities which are insignificant and miserable. What sleep is for the individual is death for species. Only the will is indestructible, as eternity of matter or supreme indifference of nature to the ruin of beings who, through death, fall back on its.

[6] On this eternal return Schopenhauer (1966, p. 1028 - 1029) in the chapter On Death and Its Relation to the Indestructibility of Our True Nature, he adds: "That return is *the cessio bonorum* of the living. Yet even here it is entered into (surrender of property) only after a physical or moral conflict, so hard does everyone struggle against returning to the place from which he came forth so readily and willingly to an existence that has so many sorrows and so few joys to offer. [...] So much the less, then, should it come into our mind to regard the ceasing of life as the annihilation of the living principle, and consequently death as the entire destruction of the man".

> every thing that wills to exist actually does exist continuously and without end.

Accordingly, in essence and substance we are like animals. There is an effort in Schopenhauerian philosophy of proving the existence of man as a phenomenon and as a will to live. The man disappears with death only in space and time, but the living principle as a thing-in-itself is not totally lost at this time, the same force that once moved this life will continue to exist. The vital forces will be related to changes in the state of organic matter in living beings and the species' occupation is fear death, as it does not have enough knowledge[7] of understanding that it will not be affected by death. Schopenhauer (1966, p. 1042) elucidates:

> Now death is the temporal end of the temporal phenomenon; but as soon as we take away time, there is no longer any end at all, and the word has lost all meaning. But here, on the objective path, I am now trying to show the positive aspect of the matter, namely that the thing-in-itself remains untouched by time and by that which is possible only through time, that is, by arising and passing away, and that the phenomena in time could not have even that restless, fleeting existence that stands next to nothingness, unless there were in them a kernel of
>
> eternity.

According to Schopenhauer (1966) it is more the “thirst for existence” than the hope for a “better world” that makes us want to live eternally, because existence in this world is not something so pleasant to the point of wanting to extend this existence to eternity. Regarding to this, Schopenhauer (1966, p. 1026) says: “what makes death so terrible for us is not so much the end of life-for this cannot seem to anyone specially worthy of regret-as the destruction of the organism, really because this organism is the will itself manifested as body.”

Schopenhauer (1966) also emphasizes that the denial of death is a distorted idea of the real meaning of existence considering how we can be afraid of something we do not know, if the only certainty we have is the physical phenomenon, otherwise, the same experiences must be experienced when reflecting on the moment before birth when the individual was nothing. The feeling of nothing being the same as we have when we are confronted with the idea of death; there is nothing to fear. This duality between death and birth is something present in the author's texts, he sees it as a way of comfort since death leads the life. We can see due to procreation and death, as well as the evident composition of individuals in will and intellect and their further dissolution, however the physical element may predominate in a singular and disturbing way; the metaphysical element, that constitutes its basis, has such a heterogeneous essence that it cannot be disputed, but we can be consoled (SCHOPENHAUER, 1966).

Thus, this fear of death conception is interpreted as an irrational way of being in the world, an incomplete understanding of what would be the phenomenal existence of the subject in the world, restricted in relation to the real knowledge of the parallel between life and death as the research discussed previously. However, death is representation, content that fills the forms of existence, and the reality behind the essence of things. The parts that affects us are merely the shapes, the configurations, the outward appearance of matter or the changes in the organic states of matter[8] that is “necessarily followed by another definite state; how one definite change necessarily conditions and brings about another definite change” (SCHOPENHAUER, 1966, p. 125).

Schopenhauer (1966) saw death as the greatest repression that nature causes to the "will to live". He sees egocentric selfishness as a limitation that man imposed around himself and precisely the death would educate this posture, as death comes to fulfill its final role, the essence of man, which is also his " will" that is going to exist only in other individuals.

An critic of human egoism, Schopenhauer (2020) offers the definition of death as the occasion of liberation from the narrowness of an individuality that must be considered the opposite of the true essence such as the totality constitutes us, this self is a loan of life that

[7]In this perspective, the author discusses the struggle between knowledge and will to live. He defines that knowledge wins and, therefore, man faces death with courage and serenity, this action is honored as great and noble: we celebrate then the triumph of knowledge over the will to live, which, however, is the core of our own essence (SCHOPENHAUER,1966). In another passage he reaffirms that from the point of view of knowledge there is no reason to fear death: as consciousness consists of knowledge, for it the death is not an evil. In fact, it is not this knowing part of our SELF that fears death, as the *fuga mortis* [the fear of death] that fills every living being is part of the blind will (SCHOPENHAUER, 1966).

[8]We should not consider death as a passage to a totally new and strange state, but rather just as the return to the state that is our own since the beginning and of which life was only a brief episode. In death, consciousness certainly perishes, on the other hand, in no way perishes what has produced it until then. (SCHOPENHAUER, 1966).

death takes back. Happy is who takes advantage of this singularity without so much anguish and fear. The philosopher illustrates this individuality: most men are so miserable and insignificant that they lose nothing with death. What may still have some value in them, that means the general traits of humanity, subsists in other men. It is to humanity, not to the individual, that the duration can be guaranteed.

Schopenhauer (2020) considers death as the greatest repression that nature causes to the "will to live". He faces egocentric selfishness as a limitation that man imposed around himself, and precisely death would educate this posture, as death comes to fulfill its final role. The essence of man which is also "will" only is going to exist in other individuals. In critical considerations of human selfishness, he presents us with the illustrious definition of death as the last great occasion to let go of the self, since death is the moment of liberation from the narrowness of an individuality that we must not consider as the innermost core of our being.

In short, the philosopher believes that man fears his own death, and consequently of his closest ones. He sees death as the greatest possible punishment capable of being applied to the other, in other words, death as a great evil is an almost universal idea, especially in the West. In many passages of Schopenhauer's essays, he starts from an empirical fact to philosophically deepen the phenomenon of death, an example is that man is not only afraid of his own death, but feels with deep pain the death of others, as the author suggests: what makes death so fearful in our eyes is not so much the end of life, but the destruction of the organism, since, in fact, it is the will that presents itself as a body (SCHOPENHAUER,1966).

The fact of having fear about death is independent of all knowledge, as the animal also escapes when someone threats it with death, although it is not aware, for Schopenhauer (1966) everything that is born brings with it the idea of preservation, that is what he calls as the reverse of “will to live” which we are. According to Schopenhauer's expressions, it is evident that:

> […] death cannot really be an evil, however much it is feared, but that it often appears even as a good thing, as something desired, as a friend. All who have encountered insuperable obstacles to their existence or to their efforts, who suffer from incurable disease or from inconsolable grief, have the return into the womb of nature as the last resource that is often open to them as a matter of course. (SCHOPENHAUER, 1966, p. 1027).

In this case, only knowledge of the metaphysics of nature can triumph over the blind and irrational will to live that is capable of unraveling the insignificance of attachment to the body putting an end to the fear of death and making man a being able to face death with courage and serenity. It would be man's victory over his own essence. On the other hand, according to the relationship between the body and the will to live, not all body fears death because it is constituted by will, as the philosopher explains:

> Man alone carries about with him in abstract concepts the certainty of his own death, yet this can frighten him only very rarely and at particular moments, when some occasion calls it up to the imagination. Against the mighty voice of nature reflection can do little. In man, as in the animal that does not think, there prevails as a lasting state of mind the certainty, springing from innermost consciousness, that he is nature, the world itself. By virtue of this, no one is noticeably disturbed by the thought of certain and never distant death, but everyone lives on as though he is bound to live for ever. (SCHOPENHAUER, 1966, p. 305).

Based on this relationship, man, as well as the animal, is born with the need of staying alive as well as the fear of being destroyed. The animal runs away and tries to protect its offspring since it is pure will to live in this man is equal by nature, being “the greatest of evils, the worst thing that can threaten anywhere, is death; the greatest anxiety is the anxiety of death”. (SCHOPENHAUER, 1966, p. 1023).

Reason can place us in a higher point of view, from which we look not at the individual but at the whole, not at the single body but the species to which it belongs. Only the philosophical knowledge of the essence of the world would make us overcome the fears of death and “whoever fears death as his absolute annihilation cannot afford to disdain the perfect certainty that the innermost principle of his life remains untouched by it” (SCHOPENHAUER, 1966, p.1029).

The man without knowledge is insistently attached to life, opposes the approach to death and desperately perceives every step he takes towards it. However, Schopenhauer approaches the two parallels, both of death and the stage before birth, giving a cyclical idea to life. Schopenhauer (1966) considers that it implies the absurdity of pretending that the kind of existence that has a beginning must not have an end; but it contains the

allusion to the fact that there could be two types of existence and, therefore, two types of nothingness. However, in the same way, one could also answer: regardless of what you are after death, and even if you are nothing, the existence you will have will be as natural and adequate for you as the individual and organic existence you have now. At the most, you would have the moment of passage to dread.

In this context, fear of death is related to the fact of loss of intellect. It links to the fact that consciousness does not depend on the phenomenon, but on the organism, and just as it is extinguished with sleep and any fainting, it is also lost with death (SCHOPENHAUER, 1966). It follows that with death we lose the intellect, we are placed in the original state, devoid of knowledge, however, it would be interesting if the intellect[9] was not extinguished with death, we would take the consciousness to our next phenomenal existence. According to Schopenhauerian metaphysics, "for the subject, death itself consists merely in the moment when consciousness vanishes, since the activity of the brain ceases […] death concerns only consciousness" (SCHOPENHAUER, 1966, p. 1026). Schopenhauer (1966) says: the loss of intellect that the will suffers with death here is the core of the phenomenon that disappears and, as a thing in itself, it is indestructible. In fact, the individual will would remember the many phenomena of which it was once at the core.

In view of this, these experiences of loss of intellect are experienced with falling asleep, with deep sleep or even with fainting, because "sleep is the brother of death, so is the fainting fit its twin-brother" (SCHOPENHAUER, 1966 p. 1026). Sleep is a daily loan that death gives and the same sensation someone has when falling asleep can be compared to the phenomenon of death. This way of softening death compared to a common act such as falling asleep demonstrates how unnecessary is the fear of death, since we die a little each day. The doctrine of indestructibility taught by nature reveals a profound connection between death and sleep demonstrates that neither endangers existence.

On this proximity of death and loss of intellect experienced daily with sleep Schopenhauer (2020) poetically reflects how long is the night of limitless time compared to life's short dream. This phrase also ponders man's attachment to eternity through a prolongation of the soul as if consciousness persisted into new existences, but as the author reminds us, life is a short dream.

The representation of the Pyramids of the Egyptians and the preparation of the body through mummification, demonstrating a whole belief in the preparation of life beyond the grave, illustrates this idea of searching for eternity. As we can see the Schopenhauerian philosophy contradicts this notion, the idea of the permanence of matter differs from the belief in eternity.

Schopenhauer (1966) exemplifies the types of death from empirical facts of loss of consciousness that occurred in these phenomena, namely, violent death as a quick death and natural death. In violent death, consciousness will end before death, external signs are perceived, but the time of suffering is less, even if the body feels the pain, consciousness will no longer exist.

The natural death resulting from old age or euthanasia is a "gradual vanishing and passing out of existence" (SCHOPENHAUER, 1966, p. 1027). In this case, the author elucidates the loss of passions, of desires that are fading away along with the stimuli related to them, the capacity for imagination and its images become increasingly distant throughout the life process.

In Schopenhauer's (2020) conception, this irrational attachment to life is meaningless, demanding the immortality of the individual in the face of life's sufferings such as old age and pain is like an attachment to nothingness, and it is better to get rid of this life so full of misery and agony and even if this world were free from misery and pain, life becomes an easy prey to boredom. In this case, the way out would be to face death as a painful solution of the bond formed by generation with voluptuousness is the violent destruction of the fundamental error of our being which the great disillusionment. It seems, according to Schopenhauer, that the end of all vital activity is a wonderful relief to the force that sustains it. This is perhaps what explains this expression of sweet serenity spread over the faces of the majority of the dead.

As we approach to the true knowledge that death can be a relief from this transitory and suffering existence, then, we do not lose anything, but the intellect and the memories associated with it, our inner being, remains unshaken. Therefore, someone can think about the reasons why we should not fear death, as a result the philosopher proposes the fact of not fearing death and points out the ways:

> But it will be asked: "How is the permanence of mere dust, of crude matter, to be regarded as a continuance of our true inner nature?" Oh! do you know this dust then? Do you know what it is and what it can do? Learn to know it before you despise it. This matter, now lying there as dust and

[9]For Durant (1996) the intellect is the only one affected by death, it gets tired but the will never. This is the reason why the intellect needs sleep; however, the will keeps itself alive even during sleep.

> ashes, will soon form into crystals when dissolved in water; it will shine as metal; it will then emit electric sparks. [...] It will, indeed of its own accord, form itself into plant and animal; and from its mysterious womb it will develop that life, about the loss of which you in your narrowness of mind are so nervous and anxious. Is it, then, so absolutely and entirely nothing to continue to exist as such matter? (SCHOPENHAUER, 2020, p. 119).

Thus, Schopenhauer shows the paths of physical and metaphysical death as something beyond human comprehension and proposes throughout the text not a manual on dying well, but a reflection of the truth about the things of the world, as he is an observer of empirical nature, of the physical and organic phenomena of matter, since man, once a body, will return to the cycle of nature as dust or in other forms perpetuated in the species. But should this be a consolation for the fears that surround human existence?

For Schopenhauer (1966), the attachment to life and the consequent escape from death occurs as a result of the will to life that promotes to existing beings which move and animate their actions. It appears in the instinct of self-preservation, in the fear of death and in the act of procreation, and in an attempt to reproduce the species. About the author's thought we can think that, in essence, man is from the same nature of other animals, in fact, he is himself the manifested nature and all men are equal by nature.

According to Schopenhauerian thought reason is the only fact that differentiates men from other animals, the fact that animals live without knowing they are going to die makes them enjoy immortality while man for the certainty of this fact differs, however , the rise of reason also brought the dismal certainty of death. In this regard Schopenhauer (1966, p. 1021):

> The animal lives without any real knowledge of death; therefore the individual animal immediately enjoys the absolute imperishableness and immortality of the species, since it is conscious of itself only as endless. With man the terrifying certainty of death necessarily appeared along with the faculty of reason. But just as everywhere in nature a remedy, or at any rate a compensation, is given for every evil, so the same reflection that introduced the knowledge of death also assists us in obtaining metaphysical points of view. Such views console us concerning death, and the animal is neither in need of nor capable of them.

Reaffirming the differentiation of the complex human life with the life of the animal that lives in the ignorance of death, we can say that the two are made of the body and, as a consequence, they fear and flee from death, since, in essence, they are from the same nature that is the will and the will to live as long as possible. This force is so indestructible capable of overcoming even death, hence, everything that dies does not die forever, but lives in the species.

Conforming this thought, it would be important thinking on the time before birth as something similar to the time after death, before there is an individual, thousands of others will have already existed and, just as after death, certainly others continued to exist in the human species, however, human understanding boils down to the spectacle of birth and death, what is behind the curtains is still unknown, what Schopenhauer (2020) reveals is that birth and death belong equally to life and form a counterweight, in this case one is a condition of the other. They are the two ends, the two poles of all manifestations of life. This is what Hindu mythology, the wisest of all mythologies, expresses by a symbol, giving as tribute Shiva that is the God of Destruction, a necklace of skulls. For them love is the compensation of death, its essential counterpart; they neutralize, suppress each other. That is why the Greeks and Romans adored these precious sarcophagi that are still seen today depicting in festivals, dances, weddings, hunting, animal fights, bacchanals; they are, in general, images of a happier, more animated, more intense life, even voluptuous, satyrs joined to goats. Its end evidently tended to concern the spirit more sensitively with the contrast of the weeping man, shut up in the tomb, and the immortal life of nature.

Life and death go hand in hand in the "spectacle" of life watched by spectators, sometimes with joy of the emergence of a new being in the world, sometimes with sadness at the illusion of its complete disappearance. However, the metaphysics of nature unveils this *Maya*[10] veil that exists between the human senses and the real meaning of existence that acts as an affirmation of life, because according to Schopenhauer (2020) nature

[10]The idea of this expression refers to Schopenhauer's influence with the book of Vedas, classical Hindu sacred works. According to Schopenhauer (1966, p. 37): "it is Mâyâ, the veil of deception, which covers the eyes of mortals, and causes them to see a world of which one cannot say either that it is or that it is not; for it is like a dream, like the sunshine on the sand which the traveller from a distance takes to be water, or like the piece of rope on the ground which he regards as a snake."

never lies, however, it says that the individual's life or death does not matter to it. This is expressed by handing over the life of the animal and also of man to all hazards, without making the slightest effort to save them.

In addition, it is undeniable to reflect on the return of matter to nature, giving rise to new beings, every time an individual dies, new living organisms appear not with the same form, because this is renewed, what is not lost is the essence that he made every living thing be born perish and die. About this eternal return of matter Schopenhauer (2020) clarifies that the matter, by its absolute persistence, assures us an indestructibility by virtue of which anyone who was incapable of conceiving another could console himself with the idea of a certain immortality.

In fact, death as it exists only in the physical phenomenon accessible to our eyes, felt daily through the process of aging, getting sick, and dying. Apart from that, the organism will always exist in its essence, as the author reiterates:

> Now if the universal mother carelessly sends forth her children without protection to a thousand threatening dangers, this can be only because she knows that, when they fall, they fall back into her womb, where they are safe and secure; therefore their fall is only a jest [...] we must attribute nature's careless and indifferent attitude concerning the life of individuals to the fact that the destruction of such a phenomenon does not in the least disturb its true and real inner being. (SCHOPENHAUER, 1966, p. 1032).

Thus, both man and the other elements of nature are constituted in their essence of pure will to live. Starting from an empirical fact, every animal flees when it is threatened with death, trying to protect itself and gaining time even if it does not have the rational element in its nature. As stated by Schopenhauer (1966, p.1023):

> The fear of death is, in fact, independent of all knowledge, for the animal has it, although it does not know death. Everything that is born already brings this fear into the world. Such fear of death, however, is a priori only the reverse side of the will-to-live, which indeed we all are.

Consequently, the fear of death is nothing more than the manifestation of the blind and irrational will to live devoid of rationality. The will to live clings to life in a way that escapes from death itself. If what makes us different from other animals is rationality, what brings us together is precisely the essence that is the will to live, this is not aware of the "indestructibility" of being by death for this reason, it either flees or creates appeals for this purpose.

IV. CONCLUSION

It is important to return the general aim proposed in this article: explaining, in a propaedeutic way, some fundamentals on the conception of death in Arthur Schopenhauer's view. Therefore, it identified the following results: at first, death only exists as a phenomenon, which is a mere representation, as a spectacle to our senses. Otherwise, it exists in the form of will as something that responds to the longings of nature. Also, it is the denial of the will to live, which flees from death in every moment for pure survival instinct.

Schopenhauer, in the manuscript on death, deals with this event as something natural and, he also uses some empirical facts for the discussion about man's condition. Throughout these lines, the death, under a naturalistic perspective, is always regarding the individual and never the species. The species belongs to the totality and is represented by the will to live that is always blind and irrational; the only thing that is lost with death is the intellect which vanishes with matter that is constantly changing. Therefore, the species, that is the will to live, for maintaining the instinct of self-preservation flees from death and fears this end as an evil. It does not have knowledge of the essence that moves things, as a result, it suffers and flees to protect itself.

Accordingly, it is not the conscience that fears death, but the will to live manifested in the species and objectified in the body and there is nothing to do, man is an ephemeral creature, his memories die, his desires also fade every day, as the vital impulses they need renewing themselves in a new existence. On the other hand, Schopenhauerian philosophy and Vedanta philosophy propose overcoming the fear of death, it is insofar as you have the knowledge of the will that is in everything and in everyone that you can see over the *Veil of Maya*, thus the illusion of this world and the physical pains can be overcome.

Death is definitely a surprise, something expected and unexpected, whose certainty does not despise the fear and pain in front of it, however, without this would be difficult philosophizing as Schopenhauer (1966) proposes, it would be complex for men to measure their actions if this was conceived as an infinite being which knows that someone does not have all the time for questioning the meaning of life. It is in old age, in the process of wasting the body through we go in the various stages of life that we walk towards death, day after day we take a loan from the sensation of death with sleep, because the intellect tires and renews itself with the falling asleep,

only the wish that even with drowsiness continues to persist for life.

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Comparison the Efficiency of Ir doped-TiO_2 Nanostructure as Risk-Reduction Materials for Toluene and n-Hexane

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***Keywords*— photocatalysts , Ir-doped TiO2, VOCs , toluene , n-hexane.**

***Abstract*—** *We have studied comparison the efficiency of Ir doped-TiO_2 nanostructure as risk-reduction materials for toluene and n-hexane. In particular, the most attractive advantages of our Ir doped-TiO_2 may be a high efficiency of VOCs treatment as well as the different mechanism of Ir doped-TiO_2 Risk-Reduction Materials between n-hexane and toluene organic compounds treatment have been studied in work. The study results show that there is a significant difference in the maximum achievable efficiency of toluene and n-hexane organic compounds degradation using Ir-TiO_2 photocatalyst. The photocatalytic material has the highest toluene treatment efficiency at 97.50 % which is much higher than that for n-hexane compound (60.03%). This outcome may be due to the difference in the structure of these two organic compounds. According to the scheme proposed by Montelio's research group [63], the alkane, after meeting the free hydroxyl radical OH·, will be cleaved into alkyl radicals; the OH· radicals are essentially electrophilic. In the case of alkanes, they will attack the stable cationic carbon-forming site on the secondary carbons. Due to the conjugation effect of the aromatic ring and the methyl radical in the toluene, the H of the ring will become flexible; therefore, toluene will be more easily decomposed.*

I. INTRODUCTION

Indoor air quality is the air quality within and around buildings and structures and an important determinant of population health and well-being.1,2 One of the sources of indoor air pollution is volatile organic compounds (VOCs), which originate from various sources and are the major cause of sick house syndrome. VOCs are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. Photocatalytic oxidation over semiconductors is regarded as a promising approach for environmental remediation. Titanium dioxide (TiO_2) is a popular photocatalyst for environmental remediation because of abundance and low material cost, outstanding chemical and photochemical stability, and high capacity for photooxidation [15–17]. However, the application of TiO_2 photocatalyst material is still limited because of the short range of wavelength affected and the low adsorption capacity of solar and indoor radiations (less than 5%) because the band gap of TiO_2 has relatively high energy (anatase TiO_2, ~3.2 eV) [5-6]. To solve this issue, the method of doping metals into TiO_2 lattice structure is considered as the sufficient approach to narrow the band gap [7-8] and decline the rate of recombination of

electrons and holes, thus improve the photocatalytical efficiency of TiO_2. M. Hinojosa-Reyes et al. [13] used the perlite granules coated with In-doped TiO_2 photocatalyst to decompose ethylbenzene gas [13]. The In-doped TiO_2 materials, containing 1.0 and 5.0 wt% of In doped, are synthesized by sol-gel method from Titanium (IV) isopropoxide and Inidium (III) acetylacetonate precusors, then heated at in 4 hours. The products showed that 5.0 wt% In-doped TiO_2/perlite photocatalyst has the ethylbenzene degradation efficiency of ~25% in 40 minutes, higher than the efficiencies of TiO_2 (P25) photocatalyst with ~15%. However, the result also showed that 5 wt% In-doped TiO2 photocatalyst has the band gap of 3.32 eV, which is higher than the band gap of commercial TiO2 (P25) photocatalyst (3.26 eV). This is also the limit of the In-doped TiO_2 photocatalyst in visible light region. Haibao Huang et al. [15] investigated a series of transition metals (Mn, Co, Cu, Ni, Fe) doping into the TiO_2 network to improve the benzene decomposition under vacuum ultraviolet (VUV) irradiation. M-doped TiO_2 photocatalysts (M = Mn, Co, Cu, Ni, Fe) were synthesized by the sol-gel method and calcined at 550ºC for 4 hours. The particle size range of the resulting photocatalyst material has about 10-40 nm, and the specific surface area is < 50 m^2/g. The results show that the Mn-doped material has the highest benzene decomposition efficiency (~58.0%) and ozone in the range of investigated materials. However, previous work has only focused on the treatment of acetone [10,12], ethylbenzene [13], xylene [11]; few researchers have addressed the problems of the n-hexane and toluene organic compounds treatment.

In the present study, we have studied comparison the efficiency of Ir doped-TiO_2 nanostructure as risk-reduction materials for toluene and n-hexane. In particular, the most attractive advantages of our Ir doped-TiO_2 may be a high efficiency of VOCs treatment as well as the different mechanism of Ir doped-TiO_2 Risk-Reduction Materials between n-hexane and toluene organic compounds treatment have been studied in work.

II. MATERIALS AND EXPERIMENTS

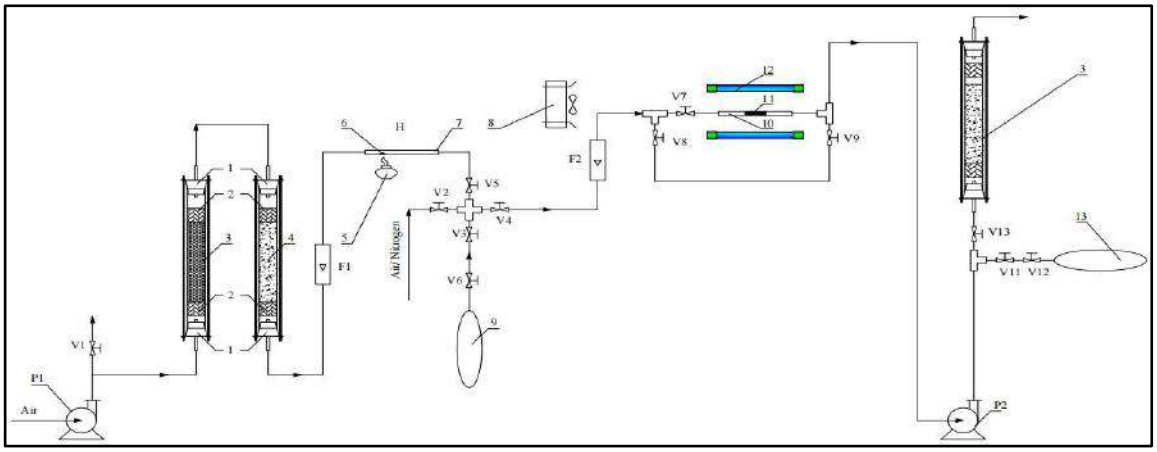
2.1 Materials

NO	Chemical	Symbol	Origin	Purity
1	Iridium trichloride hydrate	$IrCl_3.xH_2O$	Sigma Aldrich	99.9%
2	Titanium (IV) tetrachloride	$TiCl_4$	Aladdin	99.0%
3	Hydrochloric acid	HCl	Pháp	36.4%
4	Toluene	$C_6H_5CH_3$	Sigma Aldrich	99.9%
5	n-hexane	C_6H_{12}	Sigma Aldrich	99%

2.2 Experiments

The Ir-doped TiO_2 photocatalyst is synthesized followed our previous work[Ref.s]

The Ir-doped TiO_2 photocatalyst is used to decompose VOCs (toluene and n-hexan) by the system and process in the **Fig 1**



1- Rubber cap; 2- Glasswool; 3- Silicagel; 4- Activated Carbon; 5- Alcohol burner; 6- Sample drop; 7- Glassy tube; 8- Cooling fan; 9- Airbag containing inlet gas; 10- Reaction tube; 11- Photocatalyst; 12- UV light; 13- Air bag containing outlet gas

P1: Pumping air in; P2:Withdrawing air out; F1: Flow meter for inlet gas; F2: Flow meter for gas passing through photocatalyst;

Fig 1: Schematic diagram of toluene and n – hexane treatment system using nano Ir-doped TiO_2 photocatalyst in laboratory

The degradation reaction of toluene ($C_6H_5CH_3$) and n-hexane (C_6H_{12}) on the newly synthesized Ir-doped TiO_2 nano photocatalysts were carried out on a specially built treatment system. Toluene/n-hexane's concentrations were measured before and after blowing through the catalyst sample to investigate the catalytic activity of the photocatalysts. Experiment by following these steps:

- Fasten the airbag containing inlet gas to the connection position with valve V3, open valve V6 (airbag valve), set the flowmeter F1 to 1 liter/min, lock all valves. After that, stuff glass wool into the glassy tube, drop a sample (consisting of 0.02 mL toluene/n-hexane and V mL distilled water) into the sample dropper tube, heat the sample dropper tube to evaporate toluene and n-hexane.
- Open valves V5 and V3, turn on pump P1, start the timer simultaneously; collect air within 3 minutes to fill the airbag, lock the V6 airbag valve, turn off the pump and the alcohol burner, lock the remaining valves.
- Stuff 0.1g of the synthesized photocatalyst into the reaction tube, divide the amount of catalyst into three equal segments alternating with glass wool samples so that the photocatalyst is evenly distributed on the column. Turn on the radiator fan, UV light, let the light oww for 10 minutes before operating to ensure that the emitted radiation is stable, fasten the airbag to the connection position with valve V11, open valve V12 of the airbag
- Adjust the air suction pump P2 and flowmeter F2 at the investigated flow rate F, attach the airbag containing the inlet sample to the connection position V3, open valve V3, V4, V7, and V11 (valves V5, V6, V8, V9, and V13 are locked).
- Turn on pump P2, open valve V6, start the timer simultaneously, collect air for a period of time t (minutes) to be investigated with the set flow rate until the airbag reaches the appropriate tension. Lock valve V12, V11, remove the gas sample's airbag, turn off pump P2, and turn off the UV lamp.
- After gas collection, cleaning the system, glass tubes containing sample drops and catalyst column; lock valve V3, open valve V2, and V13 to blow air into the system, then close all valves to prepare for the next experiment.
- The airbag containing the outlet sample is characterized by gas chromatographic analysis to determine the concentration of toluene or n-hexane.

III. RESULTS AND DISCUSSION

3.1 Effect of Ir-doped ratio to toluene decomposing efficiency:

Table 3.1: Experiments analyze the effect of Iridium ratio on toluene decomposing efficiency

No.	**Iridium ratio** *(%)*	**Droplet volume Toluene** *(mL)*	**Droplet volume H_2O** *(mL)*	**Measured humidity** *(%)*	**Airflow rate through the catalyst** *(mL/min)*	**Gas collection time** *(min)*
1	0.5				200	15.25
2	1.0				200	15.42
3	1.5				200	15.23

Table 3.2: Gas chromatography results of determining toluene concentrations, corresponding with 0.5%; 1.0%; 1.5% Ir-doped TiO_2

No.	**Iridium ratio** *(%)*	**Toluene concentration before the reaction** C_o *(mg/m^3)*	**Toluene concentration after the reaction** C_m *(mg/m^3)*	**Decomposing efficiency** *H (%)*
1	0.5	1901	1361	28.04
2	1.0		887	53.34
3	1.5		47.5	97.50

Table 3.1-3.2 shows the concentration of toluene in the gas sample before and after Ir-doped TiO_2 catalyst treatment at different Iridium doping ratios. The investigated reaction was carried out with the condition that 0.02 ml toluene and 0.11 ml H_2O were added to the gas sample, respectively (corresponding to the measured air humidity in the gas sample of 73%). The airflow through the catalyst was 200 mL/min, and the gas sample was collected for 15 min to

fill the TEDLAR BAG 3L airbag. After completing the experiment and conducting gas chromatographic analysis, determine the concentration of toluene in the catalyst samples 0.5%; 1.0%; 1.5% Ir-doped TiO_2 is 1361 mg/m3 respectively; 887 mg/m3 and 47.5 mg/m3 respectively, with a decomposition efficiency of 28.04%; 53.34% and 97.5%. It can be seen that the decomposition efficiency of 97.5% when using the photocatalyst with an Iridium doping percentage of 1.5% is quite ideal and higher than previous studies on toluene treatment by photocatalyst. With the above results, the Iridium doping ratio of the catalyst plays a decisive role in the toluene treatment ability of the material. The 1.5% Ir-doped TiO_2 catalyst gives a much higher efficiency than the remaining catalyst samples.

3.2 Effect of Ir-doped ratio on n-hexane decomposing efficiency:

Table 3.3: The experimental parameters in analyzing the effect of Ir-doped ratio on n-hexane decomposing efficiency

No.	Ir ratio *(%)*	Droplet volume n-hexane *(mL)*	Droplet volume H_2O *(mL)*	Measured humidity *(%)*	Airflow rate through the catalyst *(mL/min)*	Air collection time *(min)*
1	0.5	0.02	0.11	~72	200	15.80
2	1.0				200	15.28
3	1.5				200	15.23

Table 3.4: Gas chromatography results of determining n-hexane concentrations, corresponding with 0.5%; 1.0%; 1.5% Ir-doped TiO_2

No.	Iridium ratio *(%)*	N-hexane concentration before the reaction C_o *(mg/m³)*	N-hexane concentration after the reaction C_m *(mg/m³)*	Decomposing efficiency *H (%)*
1	0.5	10591	4534	57.18
2	1.0		4616	56.42
3	1.5		4799	54.68

Table 3.3-3.4 shows the concentration of toluene in the gas sample before and after Ir-doped TiO_2 catalyst treatment at different Iridium doping ratios. The investigated reaction was carried out with the condition that the sample drops of 0.02 mL n-hexane and 0.11 mL H_2O added to the gas sample were 0.02 mL and 0.11 mL, respectively (corresponding to the measured air humidity in the gas sample being 72%). The airflow through the catalyst was 200 mL/min, and the gas sample was collected for 15 min to fill the TEDLAR BAG 3L airbag. After completing the experiment and conducting gas chromatographic analysis, determine the concentration of n-hexane in the catalyst samples 0.5%; 1.0%; 1.5% Ir-doped TiO_2 is 4534 mg/m3 respectively; 4616 mg/m3 and 4799 mg/m3, respectively, with a decomposition efficiency of 57.18%; 56.42% and 54.68%, the difference is not significant. It can be seen that the ratio of Iridium has but not much influence on the n-hexane decomposition efficiency of the catalyst. With a saturated hydrocarbon compound and difficult to decompose like n-hexane, the yield greater than 50% is relatively high. Unlike toluene treatment, with n-hexane, the 0.5% Ir-doped TiO_2 catalyst sample was more efficient (57.18%) than the two other rates.

3.3 Analyze and explain toluene and n-hexane decomposing mechanism of nano Ir-doped TiO_2 photocatalyst:

The obtained experimental results show a big difference in the maximum achievable efficiency of toluene and n-hexane decomposition using Ir-doped TiO_2 photocatalyst and the degradation efficiency variation trend. The photocatalytic material has the highest toluene treatment efficiency at 97.50%, much higher than the n-hexane's (60.03%). This outcome may be due to the difference in the structure of these two organic compounds. According to the scheme proposed by Montelio's research group [17], the alkane, after meeting the free hydroxyl radical OH·, will be cleaved into alkyl radicals; the OH· radicals are essentially electrophilic. In the case of alkanes, they will attack the stable cationic carbon-forming site on the secondary carbons. Due to the conjugation effect of the aromatic ring and the methyl radical in the toluene, the H of the ring will become flexible; therefore, toluene will be more easily decomposed.

Interestingly, the experimental results show that when increasing the Ir ratio from 0.5% to 1.5%, the toluene treatment efficiency increases sharply while n-hexane decreases slightly. As mentioned, metal ions in the structure of the catalytic material can act as traps to increase the lifetime of electrons and holes, leading to an increase in the reaction efficiency, which can be seen in the case of toluene treatment. However, according to equation (2.20), the OH· radicals can recombine with the metal center M (in the case of this thesis is Ir) and eliminate both OH· agent and electron – limiting the production of reducing agent $O_2^{\bullet-}$. In addition, according to the scheme proposed by Monteiro, the formed alkyl radical can create a ketone or an aldehyde [17]; some previous studies have also shown that in the presence of O_2, the ketone can produce more OH^-. The OH^- radicals after receiving holes from the first catalyst layer will form OH•, and in large quantities, the OH• will recombine with the metal centers in the later layers before reaching the n-hexane. The reaction of acetone with O_2 to give a hydroxyl can be depicted by equation (4.1):

$CH_3COCH_3 + O^- \rightarrow CH_3COCH_2\bullet + OH^-$ (4.1)

If the metal ratio in the photocatalyst is too low, it will not be enough to prevent recombination. At the same time, the distance between metal centers will be too far to effectively transfer electrons/holes to redox agents. Otherwise, the presence of many metal ions that strongly reduce the bandgap energy can also increase the recombination capacity and decrease the yield so that there's an optimal metal ratio. However, in the case of n-hexane, the interference of OH· changes the yield of n-hexane differently from toluene's degradation yield. In conclusion, each processed organic compound will have a different optimal denaturing metal ratio; the cause may be due to the by-products generated and their interaction with redox agents.

The mechanism of treatment of toxic compounds toluene/n-hexane in the air using Ir-doped TiO_2 photocatalyst materials is proposed as follows:

Electron separation process:

Electron and hole pairs would be produced whenever the sample material was irradiated with an appropriate light source. These electrons and holes would be the main oxidizing agents, but they moved freely in the lattice and easily recombined with each other:

$$Ir\text{-}(TiO_2) \xrightarrow{vis-h\upsilon} e_{cb}^- + h_{vb}^+$$

Electron trap process:

In making Ir-doped TiO_2 materials, Ir^{3+} ions were converted into Ir^{4+} and replaced in positions of Ti^{4+} ions in the crystal lattice, causing defects in the lattice. From the obtained results, based on the electron trapping and displacement mechanism proposed by Choi et al., the role of Ir in the Ir-doped TiO_2 crystal lattice was described as follows:

Electron trap center: $Ir^{4+} + e_{cb}^- \rightarrow Ir^{3+}$ (4.2)

Hole trap center: $Ir^{4+} + h_{vb}^+ \rightarrow Ir^{5+}$ (4.3)

Electron transfer process:

After trapping the electron pairs, Ir metal would transfer electrons to the redox participating agents O_2 and OH^-:

$Ir^{5+} + OH^- \rightarrow OH\bullet$ (4.4)

$Ir^{3+} + O_2 \rightarrow O_2^{\bullet-}$ (4.5)

Due to the ability to trap both electrons and holes, the treatment efficiency of Ir-doped TiO_2 catalyst was higher than other M-doped TiO_2 catalysts. If only one of the two were trapped, the reaction efficiency would be low because the charges dissociate from the trap and move to the phase interface. The trap mechanism helped prevent the recombination of electrons and holes, increasing the lifetime of photogenerated electrons, thereby improving catalytic efficiency. The water molecule adsorbed on the catalyst reacts with the hole, produces a hydroxyl radical, and oxidizes the organic compound. Photochemical reactions have been shown to depend on the production of hydroxy molecules [18],[19]. Oxygen is essential for photochemical reactions to occur. Usually, the rate of organic matter decomposition increases with oxygen concentration [20]. The treatment mechanism for organic compounds such as toluene and n-hexane by Iridium modified TiO_2 photocatalyst could be summarized in Fig 2.

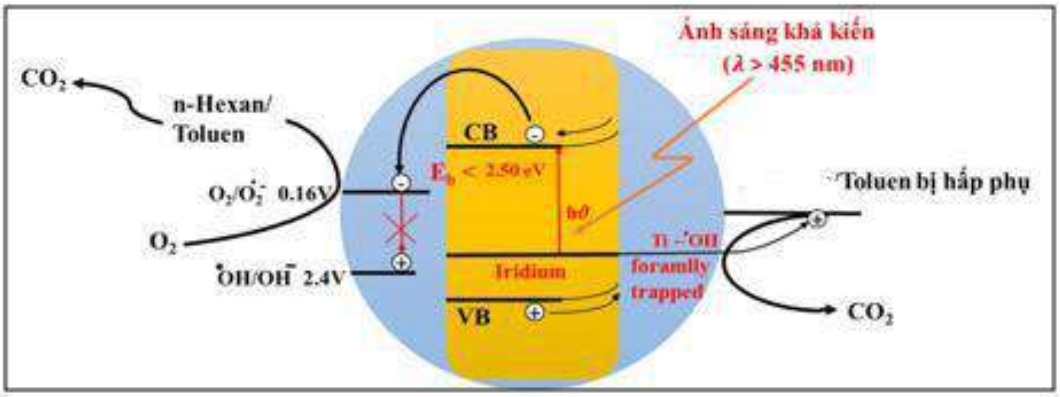


Fig 2: A proposed mechanism to degrade toxic volatile organic compounds using Ir-doped TiO_2 nano-sized photocatalyst

IV. CONCLUSIONS

The comparison the Efficiency of Ir doped-TiO2 Nanostructure as Risk-Reduction Materials for Toluene and n-Hexane is studied in this work. The study results show that there is a big difference in the maximum achievable efficiency of toluene and n-hexane organic compounds degradation using Ir-TiO_2 photocatalyst as well as the tendency to change the efficiency of the organic compounds. decomposition rate. The photocatalytic material has the highest toluene treatment efficiency at 97.50% which is much higher than that for n-hexane compound with 60.03%. The reason for this may be due to the difference in structure of these two organic compounds. The research results open up a new research direction on the application of Ir doped TiO_2 photocatalyst materials in the effective treatment of VOCs with a simple process.

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Training for Lay People on Basic Life Support Management in a Football Club

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***Keywords*—basic life support, cardiorespiratory arrest, first aid, training.**

Abstract*—The Basic Life Support comprises the set of measures used in the care of a victim cardiorespiratory arrest, aiming at maintaining their vital signs and preserving life, until a specialized team can transport it to a hemodynamics unit or intensive care unit and offer a definitive treatment.Objective:report the experience of members of an academic league of urgency and emergency in the provision of a lecture on Basic Life Support for lay people in a soccer club in the metropolitan region of Belém/PA, Brazil.Method:This is an experience report with a qualitative approach and participatory method, experienced by members of the interdisciplinary academic league in urgency and emergency, from the University of the Amazon, in the city of Belém/PA. Results na Discussions:The training of lay people in Basic Life Support using simulation plays a relevant role in improving the survival rates of cardiorespiratory arrest victims. Conclusion: The sharing and teaching of health professionals about first aid to society reveals that it is assimilating the theoretical potential in the practice that we understand and develop a quality in initial care.*

I. INTRODUCTION

Physical exercise in the conception of Caspersen *et al.* [1], its definition is the physical activity that is planned, structured and repetitive, aiming at maintaining and improving health, physical conditioning, body aesthetics or performance in competitions.

Sports or sport can also be associated with leisure, and not only professional, thus being a main activity developed by the person. And in this context, soccer is a sport that demands intermittent exercises, with varying intensity and duration, which require the athlete to have a good physical condition due to the physical effort performed [2].

The Basic Life Support (BVS) comprises the set of measures used in the care of a victim of Cardiopulmonary Resuscitation (CRP), aiming at maintaining their vital signs and preserving life, in addition to avoiding the worsening of existing lesions, until a specialized team can transport it to a hemodynamics unit or intensive care unit and offer a definitive treatment [3].

In the Brazilian population, cardiovascular diseases (CVD) are estimated to be responsible for at least 20% of deaths of people over 30 years of age, with the Brazilian northeast showing an increase in the number of deaths in 27% in the total population, 33% in men and 18% in women [4].

According to Oliveira *et al*. [5], it was found that in Pará there was an increase in the mortality rate due to cardiac involvement in the last two decades, as well as lower rates of mortality reduction due to strokes in the North region compared to the South, Southeast and Midwest regions.

In this context, the final event of CVD is represented by cardiorespiratory arrest, which culminates in a series of clinical conditions, because cardiac output is reduced, which decreases blood flow to the coronary arteries, and consequently an acute ischemia, irreversible pathophysiological changes that can lead to cell or tissue death, cerebral edema and increased intracranial pressure resulting in irreversible brain lesions if the necessary measures such as resuscitation maneuvers are not taken. [6] [7].

The simple performance of a layman, who quickly recognizes a PCR and calls for specialized help, prevents myocardial and cerebral deterioration. First Aid are procedures of high relevance for all population segments and refer to the temporary and immediate care of people who are injured or suddenly ill [8].

In some countries in Europe, the teaching of CPRaims to prepare and form effective communities to meet the CPREH [9]. Thus, immediate and adequate care to the victim of Cardiorespiratory Arrest, done through BVS, is fundamental to define its survival.

In this sense, it is necessary to provide qualified help, with theoretical and practical training, including aspects related to the importance and way of functioning of emergency assistance networks, such as the Mobile Emergency Care Service (SAMU). Considering that, one of the principles of the Unified Health System (SUS) is popular participation for the promotion, prevention and maintenance of health, it is worth noting that the training of the population in first aid and risk assessment in emergency situations contributes significantly to the reduction of injuries and mortality of the people who make up society [8].

This article aims to report the experience of members of an academic league of urgency and emergency in the provision of a lecture on Basic Life Support for lay people in a soccer club in the metropolitan region of Belém/PA, Brazil.

II. METHODOLOGY

This is an experience report with a qualitative approach and participatory method, experienced by members of the interdisciplinary academic league in urgency and emergency, from the University of the Amazon (UNAMA), in the city of Belém/PA.

The league members were invited to give an educational lecture, aimed at the management of SBV. The action was held at a football club in the city of Belém in October 2019. The study included parents and guardians of athletes who are players of the base team, aged between 10 and 14 years, in a structured environment for training, with practical scenarios organized within the club.

In total, two interactive educational interventions were carried out in twodays, using realistic simulation about BVS maneuvers, for about 30 people each day.

Parents and guardians were instructed to perform resuscitation maneuvers according to the assumptions of resuscitation science proposed for the SBV by *the American Heart Association protocol* in 2019.

The following materials and methodological resources were listed: media resource, image projector, internet, dummy simulator (*Resusci Anne - LAERDAL*®) for cardiorespiratory arrest training. The execution and management of all simulation processes were carried out by members of the academic league.

The type of intervention used was the realistic simulation, which is based on the use of techniques in daily life that allows greater immersion in specific situations, staging a scenario that enables training, in order to assist in the prevention of cases within the desired practice [10].

The action was divided into two moments: in the first, the people present were sensitized about the basic concepts about the out-of-hospital survival chain, with the use of slides *in Microsoft PowerPoint*,video and images that exemplified all the teaching explained there to them. In the second moment, people were sent to a wider space, so that the students of the league could more freely minister the practical part about the training. The training, as well as the theoretical part of the lecture, followed the

recommendations for laypeople published in the Guidelines *of the American Heart Association* 2019.

In the practical part, there was an example using a common case, which was the case of a person fainting on public road. The students explained the step by step of all that was necessary, following the protocol, explaining in practice the links that make up the survival chain focused on THE BVS and the care of extrahospital PCR for laypeople, carefully approached at each stage, not only explaining what should be done, but why each attitude, causing reflection of all the people there on the steps demonstrated.

After the practical demonstration, some people were called so that they could put into practice what they learned there all that was exposed there through the students. This type of approach is based on "Evidence-Based Practice", which according to Danski*et al*. [11]. This type of approach seeks to evaluate the quality of the exposure of facts to those being taught, and thus can correct possible flaws that occurred in the teaching/learning process.

After opening space to parents and guardians, they asked several doubts from their mistakes, and thus, the academics were able to elucidate even more comprehensive issues, such as after-hospital care, for educational purposes, and about the use of automatic external defibrillators (AD), which is not yet a reality when it comes to BVS for lay people in Brazil.

III. RESULTS AND DISCUSSIONS

The event was extremely important for the participants to acquire knowledge about Basic Life Support. Therefore, lay listeners will be better prepared to deal with a PCR situation. It is essential that more people seek training and get notions of the SBV.

In the number of people present, many did not have the discernment of how to act in a PCR emergency. This fact provided a productive lecture due to the willingness of the participants to acquire this knowledge in the area.

In a Brazilian study with lay people, about 41% of the interviewees knew about the BVS, however, only 5.8% of the participants felt prepared to apply the protocol. A strategy that can facilitate the training of the general population is the inclusion of BVS training in school curricular, initially focusing on children from the age of ten, because they constitute a more conscious, easily accessible and self-motivated group [12].

Danski*et al*. [11] reports that the teachings taught to lay people should be based on evidence-based practice, because teaching should seek methodological paths that are already presuppositions in the literature, seeking a pattern of teaching among a community, in the purpose of a common goal.

In each subject addressed and, in the managements, presented, several questions and arguments were asked, in which it allowed a greater approximation of the participants to the speakers, with the willingness of the children when they were victims, because the main focus of the lecture was how to demonstrate support to children if they suffer some intereventality in games and championships by the football club. Of the most emphasized subjects, the main ones were: contusions, traumas, CRP, CPR, epileptic crisis, convulsive crisis and choking.

The need for first aid education for lay people is intended to save lives. However, knowledge of skills and attitudes to be taken in emergency situations require educational resources such as lectures, training, practical and theoretical activities [13].

The participants were surprised about the management and materials used in the first victim care, in case of urgency and emergency, where two caps, shoelaces or bandages were used for the immobilization of the cervical spine, and the immobilization of the upper and lower limbs, shoelaces, bandages, shirts and cardboards. Such teachings with certain materials were transmitted in cases wherethe person does not come to have equipment due for intercurrent care,then was provided great curiosityand willingness to learn in the parents and guardians of the athletes of the club in relation to management and use of materials. Withthe experience, the importance of knowing and knowing how to perform thebasic managements for first aid was achieved.

CRP is the leading cause of death in developed and developing countries, occurring mainly in extra hospital environments. In view of this global panorama, considered a current public health problem, the training of lay people in BVS using simulation plays a relevant role in improving the survival rates of CRP victims [14].

Recognizing situations that endanger the life of human beings can be one of the principles of BVS techniques. Even if the mastery of these techniques is only acquired over time and with an effective practice, understanding the need for immediate help to a victim, and a basic knowledge of the necessary conducts, such as emergency phone numbers, is something that every citizen should know, whetheran adultor child. It's something that can determine the death, or survival of the victim [15].

IV. CONCLUSION

Sporadic educational actions such as giving a lecture are important in the socio-educational development of the population, regarding BVS and how to act in front of these events. The sharing and teaching of health professionals about first aid to society reveals that it is assimilating the theoretical potential in the practice that we understand and develop a quality in initial care.

In this sense, we conclude the transcendence of the SBV as teaching in the health education of the population, in view of the results exposed in this study,we highlightthe impact that can have on people's quality of life, through the reduction of morbidity and mortality.

The realization of projects in this educational level transcends the wall of universities, enabling the knowledge obtained by the members of the academic league to be shared with the community in general, giving a return from the collective and active construction, occurring mutual benefits, in which the community and students learn and share knowledge for the growth and improvement of health.

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Rural Association: Socio-Economic alternative for family Farmers

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Keywords*— *Family farming, Rural associativism, Sustainable Development. Agroecology.

Abstract*—*This study sought to describe rural associations as a development strategy for the strengthening of settled family farmers, identifying motivations and the influence of their social trajectories on the individual and collective results obtained by the members. The methodology used is descriptive with a quanti-qualitative approach, characterized as a case study. As a data collection instrument, interviews were used using a semi-structured script, informal setting and participant observation. For data treatment, content analysis and mathematical tabulation were used for data analysis. The main result of this study demonstrates associative action as rural development strategies, contributing to new opportunities,

I. INTRODUCTION

Many challenges have arisen, and many ideas defended in an attempt to establish the promotion of sustainable rural development, from an ecosocial perspective, in an attempt to promote and enable the strengthening of the agrarian sector, contributing to social justice.

The construction of this new scenario under the rural development bias involves environmental issues, such as social inclusion, the production of healthy foods, which should overcome the limited approaches related to economic growth and traditional models aimed exclusively at increasing agricultural productivity.

Thus, family farming seeks to impose itself in the different scenarios presented in the rural environment. Rural producers face several challenges to maintain themselves economically and ensure the sustainability of their production units in an increasingly competitive market, demanding, in addition to quality products, an understanding of how commercial activities work. In this context, family farming rural producers seek ways to strengthen themselves, deepen bonds and constitute social relationships as viable alternatives that enable the development and sustainability of production units. So, in line with the insertion of public policies, they seek the necessary strengthening in associativism and cooperativism.

The working class's need to organize itself as a process of establishing social order erupts with the beginning of the Industrial Revolution. Associativism, as well as cooperativism and unionism, are forms of organizations that arose from the resistance and the need to occupy space for conquests of rights, improvements, strengthening, becoming active subjects, actors capable of political, economic, cultural transformations. and social. According to Rech (2000), agricultural associations become an alternative for farmers, with regard to their insertion in local and global markets.

So, through associativism, rural organizations have more strength and representation with the government and society. In light of this, did the research lead to an understanding of the main motivations that farmers had to

form the association? Why do they adopt the principles of Agroecology in their production units? How does the association contribute to the rural development of these farmers?

Thus, this research aimed to describe the role of agricultural associations and analyze their contributions as a strategy for economic and social development, having as reference the experience of the Association of Settlers of the Bela Conquista Farm, in the municipality of Itiúba (BA), Brazil, for being a reference in agroecological production, with recognition for the achievements obtained from the social organization, the challenges faced since the occupation and conquest of its space, committed to the struggle and for contributing to the formation of other groups in the Agrarian Reform.

The article is divided into four sections, starting with this introduction, which contextualizes and gives an overview of the topic. In the next session, the theoretical foundation that supported the research is presented. Subsequently, the methodological procedures used to develop the research are presented. Then, there is the analysis of the results. Finally, the final considerations are presented.

II. THEORETICAL FOUNDATION

Association is a group of people organized for non-economic purposes, constituted as a legal entity governed by private law, institutionalized and registered in a notary's office. Rural associations become a necessary alternative for rural producers to organize themselves in the search for economically viable alternatives, based on collective actions for the benefit of their members, in a fair and equitable manner.

Associative organizations as legal personality can be constituted in the form of associations or cooperatives, with different objectives, but with the same ideological principle. It is known that this format of collective organization in the Brazilian rural environment has existed since the colonial period, but it was from the 1990s onwards that farmer associations gained a prominent position and conquered space in public policies, in the governmental sphere.

According to Callou & Tauk Santos (2008), the theme started to assume a particular relevance in questions related to associations and solidarity economy, since the public policies directed to the sector prioritize family farmers organized in associations and cooperatives. The 2004 National Policy for Technical Assistance and Rural Extension (Pnater), through the Food Acquisition Program (PAA) and the National School Feeding Program (PNAE) seek to support initiatives aimed at marketing products from family farming and its insertion in the markets. Among Pnater's goals:

> *Encourage the construction and consolidation of associative forms that, in addition to creating better forms of competitiveness, generate bonds of solidarity and strengthen the capacity for collective intervention of social actors as protagonists of sustainable rural development processes (BRASIL, 2004).*

According to Furtado's (1974) analysis, the notion of economic development that has been practiced is conceived from the perspective of capital accumulation processes, where technological progress invests in increasing the level of production. While this progress signals economic growth, it is not development. The same thought corroborates Caporal (2009, p. 24).

When dealing with sustainable development, Nascimento (2012) analyzed it under three dimensions: the environmental, which involves producing and consuming in order to ensure that ecosystems can maintain their self-repair or resilience capacity; the economic one, which supposes the increase in the efficiency of production and consumption with a growing economy of natural resources; and eco-efficiency or social, where a sustainable society assumes that all citizens have the minimum necessary for a decent life and that no one absorbs goods, natural and energy resources that are harmful to others. This means eradicating poverty and defining an acceptable standard of inequality, delimiting minimum and maximum limits of access to material goods. In short, it would be to implement the desirable social justice.

From this perspective, Abramovay (2010) admits sustainable development as a process of permanent expansion of the substantive freedoms of individuals under conditions that encourage the maintenance and regeneration of services provided by ecosystems to human societies. In this sense, human cooperation and the way in which subjects act within the scope of this cooperation are determining factors, as societies choose to use the ecosystems on which they depend.

So, the assumption of agroecology emphasizes the importance of interaction of agroecosystems with each other, as this is the only way to improve the quality of crops without sacrificing natural resources, with self-sustainability, valuing rural workers and preserving the environment. According to Pádua (2001), agroecology goes beyond the management of natural resources, configuring itself as a new bias in rural issues that must be able to align values of quality of life, with work enabling

income, a movement of democracy and political emancipation, in the same process.

In light of the above, the research is justified by the changes that have emerged in the rural sphere and the need for dynamics of territorial development has raised the interest in understanding the social relations that organize these economic and social construction transformations in the Associação dos Settlers of the Bela Conquista Farm.

III. MATERIAL AND METHODS

The research was classified as quantitative and qualitative. The qualitative approach aimed to provide an overview of a given fact, being also classified as descriptive research (GIL, 2010), characterized as a case study, an empirical study that investigates a current phenomenon within its context of reality, when the boundaries between the phenomenon and context are not clearly defined and in which various sources of evidence are used (YIN, 2005, p. 32).

For data collection, the following research techniques and instruments were applied: semi-structured interviews, informal discussion setting and participant observations. Information was collected to identify the motivations for forming the association, personal and collective motivations, the benefits for members in relation to a certain group of settled rural producers, which aspects of the individual social trajectory contributed to adopting the principles of agroecology

Ludke and André (2007) state that interview techniques are favorable for considering an efficient instrument in data collection, as it allows the immediate and current capture of the desired information, with practically any type of informant and on the most varied topics. Based on this instrument, the interview was chosen here, as it allows for a more detailed understanding of the object of study.

To understand and validate the interpretation of data, in the quantitative approach, the use of mathematical language was used, as percentages to enable better analysis of descriptions and abstract construction of the interviewees' statements for each question raised. The quantitative method is more deductive and part of a larger proposition, based on existing theories (axioms), to ascertain from field data (facts) the hypotheses of interest to the research" (SORDI, 2017, p.77).

Thus, it was possible to resort to the analysis of research already carried out, based on discussions in relation to associative practices, cooperatives, family farming, social capital, local development, by authors such as Schneider (2010), Medeiros (2010), Arruda (2006), Silva (2015), Souza (2017) Singer (2002), in addition to others who implemented projects based on these theories. As the locus of the research, the Association of Settlers of the Bela Conquista Farm, in the municipality of Itiúba (BA), Brazil, was chosen.

IV. RESULTS AND DISCUSSION

The Bela Conquista Settlement is located about 3 km from the seat of the municipality of Itiúba/BA, which is approximately 377 km from Salvador, with a population of 36,113 inhabitants (IBGE - 2013). Founded in 1989 and the production-occupation system was instituted, with about 13 hectares (ha) for each settler and the collective of an area of 112 ha.

His occupation was marked by a trajectory of struggle and resistance. Before the occupation, an Experimental Station of the State of Bahia operated at the site, in the creation of cattle, which was not successful. Thus, after more than 12 years of being exploited by some farmers, landless workers occupied the farm, being evicted with the action of the police within 48 hours, this fact was violently registered in the interviewees' memories.

With the support of the Rural Workers Union (STR), the Diocese of the city of Senhor do Bonfim (BA) and the Pastoral Commission of Terra Centro Norte (CPT) they were fundamental to the conquest of space and regularization of ownership documentation. The initial activities were carried out collectively, without the use of pesticides, maintained with the resources of their own production and despite the difficulties they sought to produce quality products, but they were not enough to invest and support their families. It was through the participation in the free fair in the city that they gradually gained respect and recognition.

Even so, the difficulties were numerous and under the guidance of the union and the pastoral, they decided to form the association to have access to public policies. The Bela Conquista Farm Settlement Association, founded on February 2, 1994, has 35 families and currently has 62 families.

The research sample corresponds to 21 families who agreed to participate, including the current President and three other previous presidents.

In data collection, the motivation most cited by respondents was the need for subsistence, given the numerous difficulties faced to maintain their production and provide for their families. After the constitution of the Association, the production that was previously only marketed by the farmers themselves at the city's open market, began to serve, for a period, government projects and programs such as the National School Feeding Plan

(PNAE) and the National Company of Supply (CONAB). Thus, the interviewees were unanimous and agreed that the settlement's associative organization increased political alliances and fundraising.

The Association maintains the creation of cattle and sheep, the sale of which is subject to meeting cash demands, as they are intended to meet the association's eventual or urgent financial needs. Its purpose is to meet the scarcity of monetary resources for investments in fixed assets, maintenance or to help a settler with financial difficulties. Another source of funding is a Collective Market, which has been financed for approximately 12 years by a government project aimed at associations. This project is intended for the acquisition of goods to supply the settled families and to produce working capital.

Understanding the need to diversify its production, the association allocated resources for the implementation of two small agribusinesses: the fruit pulp and yoghurt factory, whose productions were mainly destined to meet the needs of the PNAE; and the Cooperative of the city of Monte Santo (BA), respectively. Thus, the main actions carried out by the association are aimed at improving the physical and economic structure of its members.

Since the beginning, the association has maintained the internal agroecological policy for its cultivation and animal husbandry, as it understands that maintaining production in this standard, in addition to aligning quality of life values, maintains the self-sustainability of the conquered space.

When asked if they heard an increase in articulations for those settled in cooperation networks regardless of the association, 85.71% said no; but, regarding the increase in the strengthening of rural producers from the association, 100% said yes, as the association offered advantages to the settlers, they recognize that through the projects signed they could have an income in addition to that obtained with the fairs, for investments in improvements in housing and production, increased self-esteem and power for personal fulfillment.

In the approach to identifying whether there are conflicts of interest when participating in the association, 70% said yes, as it is a limited group, the number of members to run for management is almost always restricted and it ends up that some family members have more chances, because those closest to the president have more advantages over other members in terms of articulation. However, 100% confirm that all earnings obtained by the association are shared equally.

So, when the question was whether there were personal benefits for whoever was president, 100% said no, proving the collective conscience. The awareness of the collective space is described in everyone's statements, which state that all decisions related to the association are discussed in advance and always with voting and approval of the best proposal that allows benefits to the collective. It was identified that 75% recognize that their life trajectory, their experiences with the cause, influence the association's decisions.

In order to participate in public notices and comply with their requirements, people from the board of directors may, at some point, take a training and improvement course in the financial area to contribute to the management. At the present date of the survey, they are not participating in any project.

With regard to social relationships, 100% confirmed that the association improved the field of their relationships, becoming more cooperative and participatory in social movements. Understanding the importance of associativism was important to understand that 71.43% of respondents claim to carry out collective actions regardless of the association, the result shows that the social trajectories of these agents enabled a look towards the collective in fact. Therefore, in the participants' statements, the most prominent person was cited by 70% of respondents as one of the former president of the association and one of the founders, for having been one of the greatest articulators in achieving benefits for settled producers.

Another important result pointed out by the research is that the association became a reference in social movements, contributed to the organization of COASB - Central of Community Associations of Occupants and Settlers of the Semi-Arid of Bahia, to provide institutional support to camps and settlements in the region, later contributing to origin of CETA - Movement of Camped and Settled Workers, to which the association is still affiliated. Since its constitution, the associative organization has allowed it to contribute to the conquest of 16 new settlement areas.

Given the above, the research result demonstrates the role and importance of associativism with a broader dimension in cooperation strategies and the immense contributions in the participation in mobilizations of movements aimed at defending the rural space.

V. FINAL CONSIDERATIONS

The strength of associativism is in cooperation, through the integration of people who commit their individual contributions to the collective, ensuring their own existence. Thus, the Bela Conquista Farm Settlement Association emerged, which became an active agent in

causes aimed at family farming, especially for settled families. Influenced by the individual social trajectory, marked by struggle, but also by achievements, it made it possible to increase ties of sociability and solidarity with other groups, being recognized as the cultural identity of a people who struggle to build opportunities, conquer their space in the countryside and enable its development.

Today, the association has social visibility by residents, municipalities and institutions that recognize it for the quality of its products, defense of agroecology, for its suitability and collective commitment in the pursuit of sustainable development. Therefore, family farmers associated with practicing more sustainable forms of agriculture, keeping their production and property free of chemical products, have become a reference in the agroecology region.

That said, this article sought to describe and analyze the contributions and benefits given by agricultural associations to rural producers, specifically those from settled family farming. Their experiences linked to the association enabled new opportunities, new social relationships through cooperation networks, enabling them to carry out projects, contributing to Sustainable Rural Development.

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A Study on Accounting Management Practices in Productive units of Settled family Farmers

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Abstract*—*Family farming as a form of social organization when carrying out its productive activities and management of the establishment, are based on the connection of family members in the construction of an identity and economic and social recognition. In this context, the possibility of using Rural Accounting in Brazil as a management tool for these production units presents a profile of fragility and little applicability in the calculation of results due to limitations in relation to the quality of accounting information. Based on these assumptions, the study aimed to analyze the existence of management accounting instruments in the productive units by settled family farmers. The research characterized as a case study, of an exploratory-descriptive nature, with a qualitative and quantitative approach, resorted to the aid of narrative interviews, from semi-structured questionnaires to obtain data. The results obtained allowed us to understand that the low level of education prevents the use of registration and production control. However, it was possible to verify that social trajectories interfere in decision making, production and verification of results.

I. INTRODUCTION

In the agrarian sphere, public policies were implemented with a view to socioeconomic development, especially with regard to family farming. The Agrarian Reform program, for example, was created with the objective of promoting a better distribution of land through changes in the regime of ownership and use, which triggered the settlement of landless families. The expectation was that by making rural development possible, jobs would be generated and environmental sustainability guaranteed.

According to Neves (2006), family farming corresponds to the form of social organization in which there is the aggregation of a broad and differentiated group of farmers who, in the performance of productive activity and management of the establishment, are based on the bond of family members in the construction of an identity and economic and social recognition.

The complexity of rural issues provided the development of a new perspective, enabling dialogue and interaction of knowledge from different areas of knowledge. Thus, the articulation of a set of new institutional actors in favor of potentially favorable results began, contributing to sustainable forms of production and social organization. Therefore, studies on economic and technical feasibility are no longer suitable as indicators of success for a public policy intervention.

Thus, the need for interdisciplinarity in rural issues is admitted, since they present a management directed towards work factors. Thiesen (2008), exposes interdisciplinarity as a critical and reflective attitude. Farm (1979) shares this conception, adding that

contextualization is fundamental in order to know and integrate knowledge, aiming at new questions, new searches, that is, the transformation of reality itself.

Callado and Callado (2014) admit that rural management in Brazil is still developed within traditional criteria, with a low standard of operational and economic performance, with limitations regarding the quality of accounting information. So, rural accounting is still an instrument little used by small farmers, although it is necessary to calculate the economic and financial results.

Another aspect to consider about traditional financial management approaches is that they basically excel in analysis techniques and restrictive factors in the decision-making process, not considering the importance of the people involved. Koontz and O'Donnell (1969) highlight the importance of the individual within the decision-making process since the ability to develop alternatives is often as important as the right choice between them.

Under this premise, Accounting, as an applied social science, understands that it is human action that acts and modifies the patrimonial phenomenon of an economic-financial nature. It operates in the field of essential knowledge for the formation of decision-making agents of the most varied levels and has the ability to capture the occurrence of economic events that impact a certain state of wealth, to later quantify them and communicate their effects. Thus, sociological considerations open up a vast field of investigation for accounting, enabling interdisciplinarity with elements that allow for a better understanding of changes in the scenario and their impact on projects, as well as the phenomena that interfere with the investigated target object.

The set of various interdisciplinary concerns composed the problematic of this research, represented by the following question: to analyze the existence of management accounting instruments in the productive units of family farmers settled in the achievement of economic and financial results in the Bela Conquista Settlement, in the municipality of Itiúba/BA?

Given the above, the study is justified, as it is essential not only to meet legal requirements, but the behavioral analysis of producers and how they influence decision-making in the management of these projects. In this context, Accounting emerges with the main objective of providing this information to its various users, which is why it needs to adapt to the changes imposed by the Society's new demands. Thus, the research becomes relevant due to the global concern with environmental sustainability, above all due to the perspectives of economic and social development of family farming products.

To answer this concern, families of settlers and families associated with the association were interviewed, which, based on their narratives, made it possible to understand how the decision-making process within these social organizations takes place. The work is divided into Introduction, Theoretical Foundation, Material and Methods, Analysis and discussion of results and final considerations.

II. THEORETICAL FOUNDATION

Accounting acts in the field of essential knowledge in the formation of decision-making agents of the most varied levels. It was conceived respecting the essence of economic events which, through its capture, processing and analysis techniques, make it possible to measure the relationships arising from economic-financial facts, based on its own methodology, today enhanced by scientific rationality (IUDÍCIBUS; MARTINS; CARVALHO, 2005).

Authors such as Padoveze (2010), Hendriksen; Van Breda (1999), among others, agree with Iudícibus; Martins; Carvalho (2005) when they point out that the validation of any accounting theory is solely and exclusively due to its generated utility for users in the practical world. These authors refer to Accounting as we know it today, with the ability to first capture the occurrence of economic events that impact a certain state of wealth, then price it and, finally, to communicate their effects.

Among the specialties of Accounting Science, Rural Accounting stands out, aimed at serving rural enterprises, that is, those that exploit the productive capacity of the soil, whether through land cultivation, or by raising animals and/or transforming certain agricultural products.

In Brazil, the legislation considers as rural activity: agriculture, cattle raising, extractivism, fish farming, plant and animal extraction and exploitation and the transformation of their production. For Coelho (2009, p.75), this activity must be carried out by an economic agent considered an entrepreneur, who occupies one of the poles of the legal relationship between the State and the private. It is explored in two ways: in agribusiness and in family farming. Thus, rural activity is carried out through material, cultural, economic or legal factors.

Authors such as Lemes (1996), Souza et al. (1992) conceptualize a rural company as a production unit that stands out for having some peculiar characteristics, such as a high level of working capital and a high degree of commercialization with technical objectives aimed at its

survival, stimulated by the desire for growth and the search of positive results.

For Crepaldi (1998), rural accounting, as one of the main control and information systems for rural companies, allows, through its instruments, the verification of the company's situation under the most diverse approaches and aspects, such as structure analysis, evolution, solvency, guarantee of equity and third-party capital, return on investments, among others necessary to contribute to better planning and performance. Also, for the author, the information generated and the financial knowledge help in planning, in solving problems and in decision-making, as finance provides information that helps rural entrepreneurs to perform their duties well.

Also, according to the author, it is not only an attribute of small properties, but also identified in medium and large properties, compromising any financial and economic result. The absence of records and control makes it difficult to correctly calculate the costs of its products; production overheads that are not prorated to all products correctly; the recognition and identification of losses that are not differentiated from random, fortuitous ones from those that are part of the production process; the recognition of labor costs, with biological assets to the depreciation of property, plant and equipment; and exhaustion of pastures used in the activity, among others.

Faced with a perspective of self-sustainability, with financial autonomy to carry out new investments, rural accounting becomes a challenge for the manager of any rural enterprise.

III. MATERIAL AND METHODS

The research as to the objectives is characterized by exploratory character and descriptive qualitative nature, according to Gil (2002), exploratory research aims to provide greater familiarity with the problem, where the authors and available literature that can provide support are investigated. the search. And descriptive research seeks to describe the characteristics of a given population or phenomenon, considering that it seeks to discover ideas and data for a better understanding of the phenomenon in question.

To obtain the data, field research was carried out in the months of December/18 and January/19, using interviews and a semi-structured questionnaire as techniques. Regarding the interview, Ludke; André (2007) consider it an efficient instrument in data collection in field research, as it allows capturing the desired information, with practically any type of informant and on the most varied topics. The type of interview adopted for this investigation was narrative, as it allows for a more detailed understanding of the object of study, that is, what farmers think and how they develop their actions aimed at decision-making.

In the data analysis, an interpretive qualitative approach was used, according to Minayo (2010), it seeks to understand the phenomenon through the meanings that people attribute to it, focusing on the complexity of the human process of making sense of things, insofar as situations happen. Thus, an epistemological focus was given to hermeneutic phenomenological reflection, which, according to Van Manen (1990), is a valuable method of investigation, as it enables the description and interpretation of the phenomenon studied.

The study also resorted to statistical methods for quantification, tabulation, analysis and interpretation of the data collected, which also gives the research a quantitative character. According to Rodrigues (2006, p. 89), quantitative research is focused on the analysis and interpretation of results, using statistical measures and techniques, such as percentage, mean, mode, median, standard deviation, correlation coefficient, regression analysis, etc.

The general setting of the study was the Bela Conquista Settlement, in the municipality of Itiúba (BA), which has 62 settled family farming families, with 21 families participating in the survey. it was by chance, having been made from the respondents of the investigated target population who agreed to participate.

Once the sample was defined, the settled families were typified into two groups: G1- those constituted by squatter families, that is, those that own the land, and G2- non-squatters, representing the families of squatters' children with units active productive activities.

IV. RESULTS AND DISCUSSION

The settlement was founded in 1989 with the production-occupation system, where each settler received about 13 hectares (ha) for their productive unit and an area for the collective of around 112 ha. Horticulture and fruit growing were collectively developed. Another area, about 18 hectares, was destined to the creation of cattle and sheep in a semi-extensive way. Faced with countless subsistence difficulties, under the guidance of the union and the pastoral, the Bela Conquista Farm Settlement Association was set up, with the aim of improving living conditions and its productive units through the associative organization.

Initially, its productive activities were developed with horticulture and fruit growing. Afterwards, they dedicated

themselves to livestock, specifically the raising of cattle and sheep. Currently, it is composed of 62 families, 34 of squatters, represented by the families with the right to own the land, and 28 families of non-squatters, represented by the children who formed families, built houses, exploit the land, but do not have the right of ownership. and who live basically from family farming.

From the sample, of the 34 families of squatters, 14 participated in the survey, representing 66.67% respondents; of the 28 families of non-squatters, 7 participated in the survey, representing 33.33% of respondents. Regarding gender classification, 62% of respondents were female and 38% male. It can be seen in the responses that the woman has a social engagement and a place of active voice in the settlement, arising from the trajectory of individual and collective struggle.

It is observed that, due to occupation, the majority were in adulthood, it can be deduced that those under the age of 30, with 25.81% of respondents, were born in the settlement. The most representative range is between 56 to 65 years old with 28.57%; followed by 46 to 55 years, with 23.82%; from 26 to 45 years old with 19.05 and finally over 65 years old with 9.52%.

Of squatter families 71.43% have children working on the property and of non-squatter families 50% of the children work on the property. In terms of sales, 100% of the products from both squatters and non-squatters are sold at the city's open market.

Regarding education, 52.38% have incomplete primary education having attended only the first or second year; Incomplete High School 19.05% and only 23.81% completed high school. Of the respondents, only one squatter's daughter is studying for a degree in the Technologist in Agroecology course at the Federal University of RecôncavoBaiano (UFRB) 4.76%.

The settlers' source of income predominates as an exclusively agricultural activity at 42.86%; followed by 33.33% referring to agricultural activity and other income due to retirement. Other families supplement their income either with the Bolsa Família 9.52%; with a university scholarship 4.76%; civil servants 4.76% and in salaried work in one of the shifts 4.76%.

The identification of the profile of the settled families was important to verify the practice of accounting instruments in controlling expenses. Assess whether factors such as gender, education, age group influence the adoption of these criteria in managing their production. When analyzing the results of the survey, it was found that there was no record of their activities, even in notebooks, passbooks, or loose forms, only one of the respondents claimed to write down their expenses in a passbook. Accounting for what is produced is not a habit and they keep this information in memory, so that many of them are not properly processed. This result may be related to low education as 52.38% have incomplete primary education, in relation to age group, this data influences because it is justified by virtue of the representativeness of the squatters' families. As for gender, no influence was identified in relation to recording or not the information, in the speeches a question of lack of experience in the group is evident.

Another aspect that draws attention is the fact that the estimated average income from earnings reported by agents varies considerably, which indicates that they are effectively unable to maintain a value that can guarantee their sustainability. Of the squatters' families, 42.86% earn up to the minimum wage and 57.14% more than the minimum wage. While the families of non-squatters, 87.50% earn up to a minimum wage and 42.86% more than a minimum wage. Note that this disparity is related to the age group of the squatters and the fact that they add the earnings from retirement as a complement to their income.

With the cooperation projects through the association, there was an improvement in the quality of life and an increase in family income, but at the time of the survey, the respondents were not participating in any project.

The conception that these agents have of gains and what they consider as profits or losses is not real, as all expenses related to what is produced and sold are not effectively considered. In both agricultural and livestock activities, in the respondents' understanding, some expenses are not recognized as production costs or marketing expenses, because they are carried out by them. The cost of labor is particularly noteworthy, as it represents services provided by them directly in their production units, values for handling the cattle and labor applied by other squatters.

It was also identified that they do not have the habit of making an Inventory of Fixed Assets, nor do they recognize the loss of useful life of the assets as a cost of production, they also disregard the depreciation of equipment, exhaustion and losses in production.

The criterion used by the majority to find out if there is a gain is when the merchandise is not returned from the open-air market. Part of the production is consumed by the families, however, as there is no record, they do not know how much of the production is consumed, but they estimate that they save 70 to 75% of their own production, instead of purchasing from third parties. The lack of this recognition also compromises the verification of production results.

In the livestock activity, gains vary considerably, as some calf births are sometimes not registered and losses due to death are not recognized in the results. Thus, in livestock activities, although there is registration of males and females, stock control does not separate the Breeders and Breeders. Accounting implies the non-recognition of Biological Assets in the correct group of Current Assets and Non-Current Assets.

When asked about decisions about production, creation and marketing if they are planned in advance, 100% of respondents said no. However, the producers have internal policies for agroecological production, care and respect for the environment and the preservation of social space.

When carrying out purchases, sales, investments, calculation of gains and losses, 100% of respondents also said that they do not register. Due to the risks inherent in the production and raising of animals, 100% stated that there are no Contingency plans to remedy possible losses.

Although the financial obligations are recorded in total forms, as they know how much comes in and how much comes out of the box, however, the research results demonstrate a deficiency in both financial and accounting registration and control, which makes it difficult to organize, plan and make decisions. to produce and how much to invest, as they are carried out on a daily basis, in the immediacy of the facts. In this scenario, the decision-making process is quite empirical and rudimentary, which compromises preventive actions to remedy possible losses in advance.

When analyzing the results of the respondents of the settlers who participate in the association, however, these same agents, when they assume a position of management, proceed with the records of operations by productive units, however this information only indicates entries, exits and balances of operations, but it was found there is no record in greater detail of their productive activities. Resources from projects have better control over execution, but limited entries and exits and calculation of balances, with all expenditures being recorded. Initially, they stated that they wrote it down in a booklet and later went on to a spreadsheet to carry out the monthly accountability, presented at the meeting and registered in the Minutes.

The result corroborates studies by Marion (2014) regarding debates on the use of information on cash flows and that the Cash Flow Statement (DFC) is the main accounting report used in the rural sector in the United States and in Brazil. Thus, as results already presented by Crepaldi (2007), as the limitations in the quality of accounting information generated in rural properties compromising financial results.

The study raises a question to consider that the results point out, is the importance of not retaining only economic, but cultural, social and historical nuances that influence decision-making in the context of the reality of rural producers, as it was noticeable in the speech of some squatters whose trajectory influenced the decisions, between two possible alternatives, the choice always prevails in order to ensure the improvement, development and sustainability of settlers, thus, raising resources is important but cannot transgress internal agroecology policies, for example, applied in their productions.

Understanding the trajectory of these agents, and from the sociological perspective of accounting, it appears that accounting is not totally rational and should not be used only to obtain gains.

V. FINAL CONSIDERATIONS

The Bela Conquista Settlement, as a social space, identified itself as an evaluative and devoted posture by agents to causes aimed at family farming, especially to settled families. The speeches of struggle and achievements demonstrate a cooperative relationship that culminated in the opportunity to conquer their right to be in the countryside, conquered respect and legitimacy in their social space and today the settlement has social visibility by the residents of the municipality and surrounding region, who recognize the quality of production.

The research fulfilled its objective and emphasizes the need to familiarize and insert routines in the agents' listings for the records and controls of their production as well as their heritage assets, as with simpler records, their data will be structured and will be able to obtain more reliable information about their reality. . By learning to group expenditures according to the different economic activities and in specific records, the releases will contribute to better economic and social results, they can help for a more elaborate planning of their productions and creations, that is, make an action plan if necessary. in accordance with the relevant particulars of their productive activities.

It is known that the low level of education prevents the use of more sophisticated methods in the decision-making process, in addition to the fact that most of the information recorded is informal. Thus, this research suggests a look at settled family farming producers, new research from other perspectives and public or private actions that may contribute to a management information system compatible with their needs and level of access.

That said, the compression of the trajectory of these agents became relevant, as it allowed them to understand their social practices, the way they deal with their production and decision-making, how they seek to optimize their resources and results for their livelihood and thus mobilize them to serve their individual and collective perspectives.

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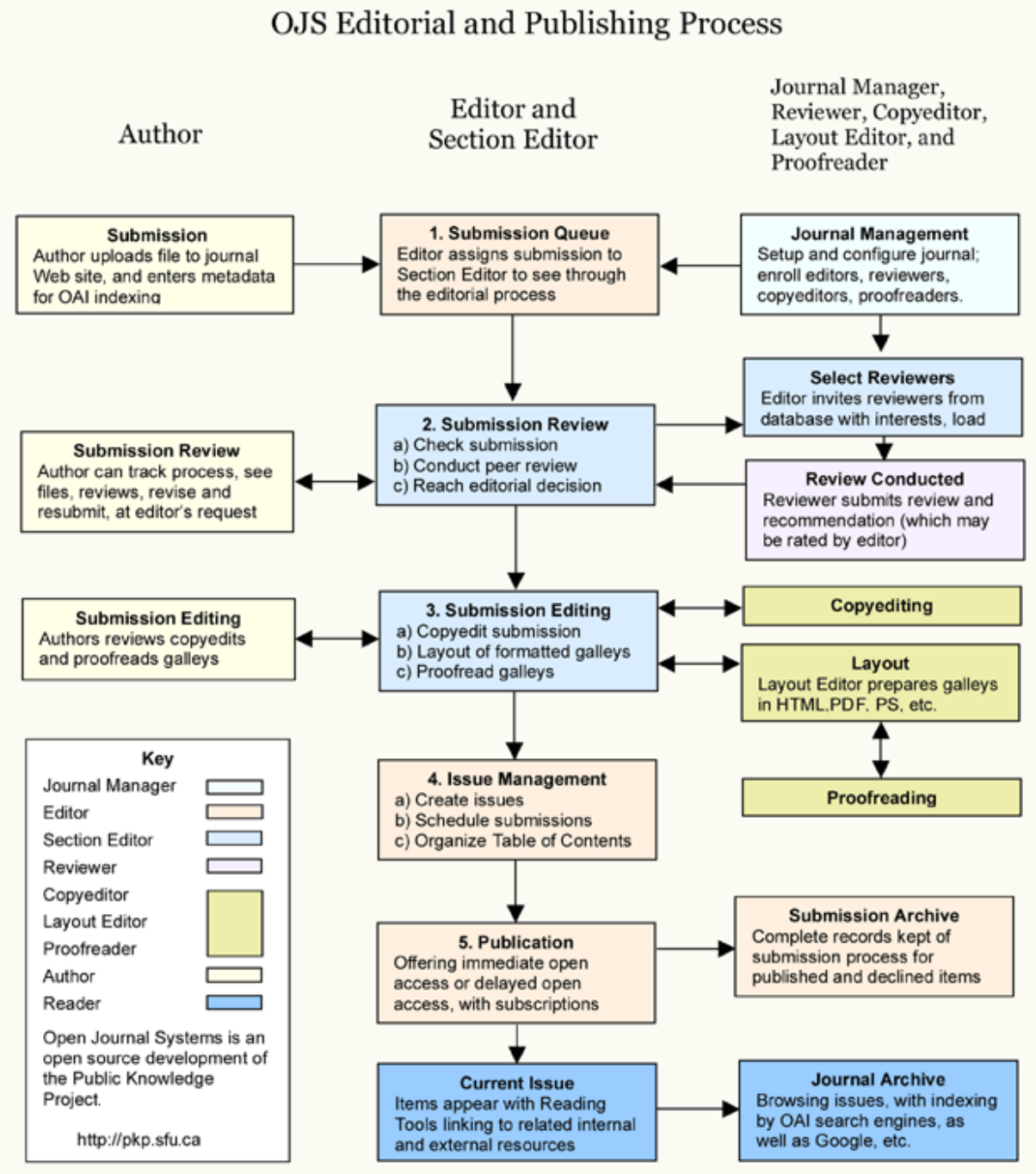

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