ISSN : 2349-6495(P) | 2456-1908 (O)

International Journal of Advanced Engineering Research and Science

(IJAERS)

An Open Access Peer Reviewed International Journal

Journal DOI: 10.22161/ijaers

Issue DOI: 10.22161/ijaers.6.9

AI PUBLICATIONS

Vol.- 6 | Issue - 9 | Sept, 2019

editor@ijaers.com | http://www.ijaers.com/

International Journal of Advanced Engineering Research and Science

(ISSN: 2349-6495(P)| 2456-1908(O))

DOI: 10.22161/ijaers

Vol-6, Issue-9

September, 2019

Publisher

AI Publication

Email: editor.ijaers@gmail.com; editor@ijaers.com

Web: www.ijaers.com

FOREWORD

I am pleased to put into the hands of readers Volume-6; Issue-9: 2019 (Sept, 2019) of **"International Journal of Advanced Engineering Research and Science (IJAERS) (ISSN: 2349-6495(P) | 2456-1908(O)" ,** an international journal which publishes peer-reviewed quality research papers on a wide variety of topics related to Science, Technology, Management and Humanities. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release print issue also, but this decision the journal issue will be available in various library also in print and online version. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind. This journal has DOI (Digital Object Identifier) also, this will improve citation of research papers. Now journal has also been indexed in **Qualis (Interdisciplinary Area) (Brazilian system for the evaluation of periodicals, maintained by CAPES).**

I thank all the authors of the research papers for contributing their scholarly articles. Despite many challenges, the entire editorial board has worked tirelessly and helped me to bring out this issue of the journal well in time. They all deserve my heartfelt thanks.

Finally, I hope the readers will make good use of this valuable research material and continue to contribute their research finding for publication in this journal. Constructive comments and suggestions from our readers are welcome for further improvement of the quality and usefulness of the journal.

With warm regards.

Dr. Swapnesh Taterh
Editor-in-Chief
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Vol-6, Issue-9, September 2019

https://dx.doi.org/10.22161/ijaers.69.1 *ISSN: 2349-6495(P) | 2456-1908(O)*

Adhesion and Abandonment of Hansen's disease Treatment in Maranhão

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***Abstract*— *The abandonment and irregularity of treatment are the main causes of the impasses in the control of Hansen's Disease, since they lead to a greater risk of transmission, creating a serious problem for public health. The objective of the research was to evaluate the causes of the abandonment of Hansen's Disease treatment in the State of Maranhão. Data from the Information System and Diseases and Notification related to the disease were analyzed in a total of 33,308 cases reported in the Health Units of Maranhão from 2008 to 2014 and analysis of 60 records in a field survey in a reference hospital for Hansen's Disease in the State. The multibacillary operational classification was the predominant one, with 23,320 cases (77.6%), with a more frequent clinical form. Males had the highest frequency (64.4%), aged 20 to 34 years (19,357 cases). As for ethnicity, the brown breed had the highest frequency and there was preponderance of low level of education, from 1st to 4th grade, followed by the illiterate. Of the 775 patients who initiated treatment, 60 were either absent or abandoned. The main reasons for abandonment were: side effects of medication, lack of understanding of information about the disease and identification of symptoms, prejudice, idea of religious healing, non-acceptance of the disease and embarrassment of going to health units every month.*
Keywords*— *Transmission. Hospital. Reasons.

Resumo— *A hanseníase é uma doença infecciosa e contagiosa marcada pelas desigualdades sociais e tem como uma das fontes principais da disseminação da doença a hanseníase na forma clínica virchowiana. Evidencia assim um grave problema de saúde pública no Estado do Maranhão, bem como no Brasil. O Objetivo do presente estudo foi analisar o comportamento da incidência da hanseníase virchowiana a partir das notificações do SINAN do Estado do Maranhão no período de 2008 á 2013. Trata-se de estudo epidemiológico descritivo, retrospectivo de abordagem quantitativa. O resultado deste estudo estimou a taxa de incidência da hanseníase virchowiana no estado do Maranhão de 10,3 casos por 100.000 habitantes e a taxa média incidência, 15,1por 100.000 habitantes no sexo masculino. 1% (3) dos municípios apresentam taxa média de incidência muito alta (20,00 a 39,99); 17% (37) apresentaram taxa media de incidência alta (10,00 a 19,99); 55% (120) apresentaram taxa media de incidência média; 15% apresentaram taxa media de incidência baixa e 12% dos municípios apresentam um silencio epidemiológico. Os resultados deste estudo são indicativos que tem como finalidade, subsidiar gestores da saúde e educação do estado dos municípios do Maranhão nos processos de planejamento, gestão e avaliação de políticas e ações de controle da hanseníase, portanto, dentre as medidas a serem adotadas, está a intensificação da busca ativa de casos da hanseníase na forma clínica virchowiana, diagnóstico, vigilância de contatos, tratamento e acompanhamento dos casos até a cura com engajamento na atenção primaria a saúde, afim de melhoria da qualidade da assistência e controle efetivo daendemia.*
Palavras clave*— *Saúde Pública, Infecção, Incidência.

I. INTRODUCTION

Hansen's Disease is a contagious disease caused by Mycobacterium leprae. which exists since before Christ. Society and even religious institutions were cruel to Hansen's Disease sufferers from antiquity to the present day. Lack of knowledge about the disease only made lepers worse. And even when the Hansen's Disease bacillus was identified by the Norwegian physician

https://dx.doi.org/10.22161/ijaers.69.1 ISSN: 2349-6495(P) | 2456-1908(O)

Gerhard Armauer Hansen in 1873 and treatments began to emerge, the biased and distant behavior towards the lepers remained. In the Modern Age isolation, which had been practiced since antiquity, became compulsory, leading to the creation of leprosariums, places where patients were abandoned, without assistance, and eventually died, leaving offspring who were already born with the disease. Even after the discovery of the tuberculosis bacillus in Brazil, Hansen's Disease sufferers were treated with neglect and discard. Even considered a public health problem in Brazil Republic, compulsory notification was not put into practice due to the difficulties of diagnosis, doctors of that time classified Hansen's Disease as other dermatological diseases. And for a long time all individuals with cutaneous manifestations throughout a disease were considered lepers.

Although programs for the eradication of the disease, Brazil, can not achieve the goals of the United Nations - UN[1], cites that Brazil presents "about 30 thousand new cases per year, corresponding to an average of 15 people contaminated for every 100 thousand inhabitants. Brazil is the only country in the world that has not yet reached the goal of the World Health Organization - WHO by 2015, of up to 10 cases per 100,000 inhabitants "[2]. The studies on the possible causes of the abandonment of the Hansen's Disease treatment can contribute significantly to a reflection on the use of its results in the elaboration and implementation of projects of public policy and control programs.

The serious problems caused by irregular treatment and abandonment constitute the main impasses for the control of the disease. Another barrier to treatment is the side effects of medication, because in most patients there are bad and painful reactions to the effect of medications. Many patients believe that the medication acts in a contrary way, aggravating the disease and even provoking other diseases, this being another frequent reason for abandoning treatment.

The lack of adherence to treatment is one of the factors for the increase of cases and that non adherence occurs for several reasons, mainly because the affected one resists accepting the disease, because despite the existence of treatment there is still a lot of prejudice regarding Hansen's Disease. Associated with this is the lack of knowledge about the disease, since the patients' statements reveal that the knowledge acquired came from experience with the disease and not from information passed by health professionals[3].

Regarding the obstacles to adherence to the treatment of the person with Hansen's Disease, Garcia et al. [4] points out as one of them the health professional's own contact, which can be fraught with fear and prejudice.

Most people with Hansen's Disease belong to a class of lower purchasing power, a condition that may make it difficult to understand the disease and thus its adherence to treatment. Low or no schooling leads to a misunderstanding of the terminology employed, or even the shame of these people to expose themselves are barriers to recognizing the need for treatment[4].

When reporting difficulties in adhering to Hansen's Disease treatment, nurses participating in a study stated that there is no good patient adherence due to the lack of knowledge about the importance of treatment, the lack of clarity in the guidelines given to patients and also as a result of the drug reaction[5].

The diagnosis of the disease can be seen by the patient as frustration and feeling of impotence, because it brings the person physical, social and even personal obstacles, making it difficult to satisfy their needs. This situation requires the health professional to help the patient to develop positive attitudes, so that he can re-establish his life plan, stimulating him to dialogue and participate in his treatment. The patient's first contact with the doctor may influence treatment adherence[6].

Hansen's Disease is an aggressive disease that causes loss and the affected person faces a number of problems such as bias, rejection. In addition to these, when adhering to treatment, life difficulties do not diminish, therefore, medication eventually results in a variety of side effects, reactions of the body, often understood as non-effectiveness of this medication. The reactions lead the individual to abandon the treatment, which presents as a serious obstacle to the goal of extinction of the disease. For this disease, if there are obstacles to adherence to treatment, there are many difficulties in continuing with it.

Among the actions of the Ministry of Health in combating Hansen's Disease one of them is to prevent the patient from abandoning treatment. The causes of the abandonment are discussed, but the studies focus mainly on the clinics. The abandonment and irregularity in treatment are constant concerns, since they mean the maintenance of the chain of disease contagion, the appearance of sequelae and incapacities, and even resistance to PTQ[7]. Considering the consequences of abandoning treatment, practitioners and scholars agreed that it was important to identify the causes of such abandonment. The Ministry of Health considers cessation of treatment those in which the paubacilar and / or multibacillary who did not complete the number of doses of the medication in the expected time and did not attend the health service in the last twelve consecutive months. Non-attendance at monthly appointments for the supervised dose characterizes a faulty patient.

https://dx.doi.org/10.22161/ijaers.69.1 *ISSN: 2349-6495(P) | 2456-1908(O)*

Supervised treatment contributes to decreasing cessation of treatment and increasing the number of people cured[8].

This study aims to identify the reasons that influence the adherence and abandonment of Hansen's Disease treatment in a public hospital in the State of Maranhão.

II. METHODOLOGY

The research is an exploratory study, with bibliographical and documentary research, carried out to present data such as those occurred in the period from 2008 to 2014, in order to check the degree of adherence and abandonment of patients with Hansen's Disease in the State of Maranhão. A descriptive survey aims to study the characteristics of a given reality, to raise opinions and attitudes of a population and to discover the relationship between variables without identifying factors that determine the occurrence of the phenomena.

The study was conducted in the State of Maranhão, Brazil. The State has 217 municipalities, distributed in an area of 331,937,455 km^2, with a population of 6,774,789 inhabitants, whose demographic density is 19.81hab / km^2[9] . At the AquilesLisboa Hospital (HAL), located in Ponta do Bonfim, separated from the city center by the Bacanga River, in the city of São Luís, the semi-structured interviews were carried out, from 01/11/2016 to 02/01/2016. The choice of HAL was due to the fact that it is the reference hospital in the treatment of Hansen's Disease in relation to the other units that act in the treatment of the disease in the state of the MA.

The sample of this study was composed of 60 records of patients registered at the Hospital AquilesLisboa, attended from 2008 to 2014, whose recorded data were analyzed, to obtain information that led to the identification of the causes that lead to adherence and abandonment of the treatment. It should be emphasized that this study had as a criterion the quantification of active patients, with cognitive status preserved.

The study considered as inclusion criteria the registration of the cases in the medical records of the AquilesLisboa hospital, with sufficient information for analysis, as well as data from the Notification of Injury Information System - SINAN referring to cases of Hansen's Disease registered in Maranhão in the period of 2008 to 2014, from which it became possible to quantify the cases of adherence and abandonment of the treatment and excluded, the cases that although reported in the records of the AquilesLisboa hospital and SINAN, were cases of recidivism as well as of cases not reported in SINAN and in the Reference Centers for the Treatment of Hansen's Disease, in the State of Maranhão, from 2008 to 2014.

To collect data to characterize the main reasons that led Hansen's Diseasepatients adherence or abandonment of the treatment was performed by analyzing the medical records of patients with Hansen's Disease of the Hospital AquilesLisboa and the quantitative data of SINAN. These data come from the Hansen's Disease notification and research records between the years 2008 to 2014.

1st stage - Initially a bibliographic research was carried out, in order to verify, based on a specific literature, the essence of this study.

2nd stage - Direct observation was made to the ex-patients remaining from the Bonfim colony. The technique of observation uses the senses to obtain certain aspects of reality, is not restricted to seeing and hearing, but also analyzing facts or phenomena to be studied.

3rd - A semi-structured interview was conducted with 12 residents of the Colony and 7 professionals working at the AquilesLisboa hospital, considering a more consistent and complete measurement. The interview was conducted through a questionnaire composed of 16 questions; The interview period lasted from September 28 to October 28, 2016, during the afternoon shift, with a duration of 30 minutes, within a period of one month on alternate days, which consisted in verifying the main causes that commonly lead to adherence and abandonment of Hansen's Disease treatment.

4th stage - Analysis of 60 records of follow-up and collection of secondary data through the National System of Notification Diseases - SINAN.

The project was submitted to the Brazil Platform, the Unified National Base of Records and Research involving human beings for the entire CEP / CONEP system (APPENDIX), the same was approved on 01/09/2017 by the ethics and research committee of the São Domingos Hospital.

III. RESULTS AND DISCUSSION

In the case of Hansen's Disease in Maranhão, he deported himself to the former Colonia AquilesLisboa Sanitary, also known as Colônia do Bonfim, founded on October 17, 1937, in order to isolate people with Hansen's Disease[10]. Currently known as the Aquiles Lisbon Hospital, the unit had its treatment method modernized and its patients no longer live in isolation as in the past when the site was chosen because it was far from the city and difficult to access[11].

According to the survey, Maranhão state authorities stated that the Bonfim Colony had a capacity of up to 400 people affected by Hansen's Disease, although hospital records, even precarious ones, do not confirm this information12. Currently the people who live in the houses of the old Bonfim Colony are classified as graduates. Studies of the time indicate that the hospital built had a more symbolic purpose than treatment. The objective was to unravel the image of Maranhão in

https://dx.doi.org/10.22161/ijaers.69.1 *ISSN: 2349-6495(P) | 2456-1908(O)*

relation to the picture and numbers of Hansen's Disease sufferers, which until then was one of the largest in the country.

In principle, patients were placed in the Gavião Asylum, a kind of warehouse where they were abandoned. However, it was from 1937 that these patients were referred to the Colonia AquilesLisboa Sanitary, and from then on they forgot the previous life, the relations, beginning a new stage of life without knowing if they would return to live with the family and friends[12].

According to information obtained in the interview with the chief nurse W. M, on September 6, 2016, AquilesLisboa functions as a reference hospital in dermatology, focusing on Hansen's Disease, only with outpatient care, with 15 beds for cases in which there is need of hospitalization. According to this professional, non-adherence to the treatment of Hansen's Disease has as main obstacle the prejudice suffered by the person carrying the disease, the side effects of medications, which mostly cause disorder to the patient.

We identified a total of 33,308 reported cases of Hansen's Disease in the Health Units of the state of Maranhão from 2008 to 2014. Of these, 5,842 cases occurred in the municipality of São Luis - MA. Regarding the operational classification and clinical form, it was verified that there was a predominance of Multibacillary operational classification with 23,320 cases (Table 1), it should be noted that among these, the clinical form Dimorfa was the most frequent. In the total population studied, there was a higher frequency of reported male subjects with 19,357 cases and aged between 20 and 34 years (Table 2).

Table 1 - OperationalClassification

Type	Year							Total
	2008	2009	2010	2011	2012	2013	2014	
Paucibacillary	1.755	1.474	1.537	1.420	1.408	1.262	1.123	9.988
Multibacillary	3.376	3.224	3.321	3.236	3.301	3.504	3.358	23.320

Source: SES/MA/SINANNET/TABWIN[24]

During the research at the Aquiles Lisboa Hospital, 60 (sixty) medical records were analyzed, where 59% of the medical records are male, and 41% female, which corresponds to 16 medical records. This reference to males increases the hypothesis that men may be more prone to disease by the conditions: greater interpersonal relationships, greater resistance to participating in disease prevention programs, greater exposure to the environment, among other cases (Table 2) .

Table 2 – ByGender

Gender	2008	2009	2010	2011	2012	2013	2014	Total
Female	2.065	1.933	2.039	1.971	1.957	2.088	1.898	13.951
Male	3.067	2.768	2.819	2.685	2.753	2.679	2.587	19.357

Source:SES/MA/SINANNET/TA BWIN[24]

When the variables, gender and age, were analyzed, a greater frequency was observed in males (age group 20 to 34 years, Table 3); however, the lowest age was 1 year and the highest was 88 years, being the average between 20 and 49 years. In the age range between 20 and 34 years, analyzing hypothetically refers to the issues related to the beginning of emancipation, freedom of choice, greater probability of multiplying relationships, among other factors. As for younger age (1 year), the idea of direct transmission of family members is also reinforced due to lack of information and care for the patient and the child. There were also withdrawals due to abandonment of treatment in all the analyzed years, with great relevance also in 2008, where there were 384 cases of patients who abandoned treatment of the disease.

The GenésioRêgo and AquilesLisboa Health Units were the ones that presented the highest number of Hansen's Disease cases, with 1,940 and 775 cases, respectively, in the period from 2008 to 2014, since these units are references for the treatment of the disease.

https://dx.doi.org/10.22161/ijaers.69.1 *ISSN: 2349-6495(P) | 2456-1908(O)*

Table 3 - Age Group

Year	1-4	5-9	10-14	15-19	20-34	35-49	50-64	65-79	80 e+	Total
2008	25	150	276	401	1.420	1.161	1.064	520	115	5.132
2009	12	150	284	320	1.370	1.035	922	525	82	4.700
2010	16	145	297	329	1.413	1.075	903	522	78	4.778
2011	17	156	284	308	1.247	1.062	971	501	110	4.656
2012	19	143	254	281	1.189	1.070	991	537	126	4.610
2013	10	155	262	273	1.237	1.048	1.017	553	111	4.666
2014	10	155	262	273	1.237	1.148	1.017	553	111	4.766

Source: SES/MA/SINANNET/TABWIN[24]

According to the SINAN Information and Injury and Notification System, in Maranhão, 33,308 cases of Hansen's Disease were reported in the period from 2008 to 2014, of which 5,842 were in the municipality of São Luís - MA. The variation in cases increased and from 2012 to 2014, the number of cases reported decreased, as shown in table 4. In the survey, 775 cases of Hansen's Disease were identified, registered only at the AquilesLisboa Hospital.

The highest percentage found in the city of São Luís-MA was male with 3,315 cases reported. With regard to age, a higher frequency was observed in the population aged over 14 years. For Veronesi[13] the greater or lesser prevalence of cases depends on the exposure to multibacillary patients with viable bacilli. The age of the patients ranges from infancy to older people.

Table 4 - Adherence to the treatment of Hansen's Disease in SINAM between 2008 and 2014

HEALTH UNIT	2008	2009	2010	2011	2012	2013	2014	Total
Health Center Amar	7	14	17	8	6	5	4	61
Health Center Bezerra M.	16	8	6	5	5	5	2	47
Health Center Clodomir P.	8	7	5	6	4	3	1	34
Health Center Cohab Anil	11	10	10	5	5	3	2	46
Health Center da Liberdade	0	0	0	1	0	0	3	4
Health Center da Liberdade	0	0	1	0	1	3	2	7
Health Center Vila Lobão	4	3	0	5	0	1	0	13
Health Center Fátima SAE	46	43	42	36	32	43	87	329
Health Center de Pedrinhas I	4	3	2	0	0	0	2	11
Health Center de pedrinhas II	1	0	0	0	0	0	0	1
Health Center Djalma Marques	3	0	0	0	0	0	0	3
Health Center Djalma Marques	11	8	15	18	9	4	12	77
Health Center do João Paulo	7	5	4	1	3	0	1	21
Health Center Radional	3	3	5	0	0	1	0	12
Health Center Tibiri	8	4	9	4	3	3	4	35
Health Center Turú	37	45	49	21	24	36	24	236
Health Center Antonio G.	3	5	0	0	0	1	7	16
Health Center José Macieira	6	7	3	2	0	0	2	20
Health Center José Frazão	3	6	2	2	1	2	0	16
Health Center Fabriciana M.	13	13	10	4	2	3	1	46
Health Center Gapara	1	1	0	0	0	0	0	2
Health Center Genésio Filho	15	13	18	3	3	1	3	56
Health Center Genésio Rego	85	59	151	420	434	399	392	1.940
Health Center Itaperta	0	0	1	0	0	0	0	1
Health Center Janaína	0	8	8	2	5	8	2	33
Health Center João de Deus	4	5	2	0	0	2	3	16
Health Center L. Vasconcelos	0	2	3	2	0	3	7	17
Health Center Maracanã	0	2	0	1	2	0	1	6

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Health Center Maria Lourdes	0	1	0	0	1	0	0	2
Health Center Nazaré Neiva	9	7	7	6	8	4	2	43
Health Center Quebra Pote	0	3	0	3	3	7	0	16
Health Center Salamão	13	25	13	12	12	12	4	91
Health Center Santa Barbara	12	16	5	6	4	1	1	45
Health Center São Cristóvão	6	2	3	5	4	3	0	23
Health Center São Francisco	8	4	9	3	2	2	1	29
Health Center São Raimundo	3	7	1	0	0	0	0	11
Health Center Thalles Ribeiro	8	11	6	4	2	7	5	43
Health Center Vila Embratel	11	10	2	11	8	8	1	51
Health Center Vila Itamar	6	8	5	4	1	2	1	27
Health Center Vila Nova	3	2	0	0	0	0	0	5
Health Center Yvis Parga	2	2	0	1	1	0	1	7
Aquiles Lisboa Hospital	56	70	81	85	122	193	168	775
AdersonSo.Vila Luizão Hospital	0	3	3	8	39	7	0	60
Djalma Marques Hospital	0	0	0	1	0	0	0	1
UFMA Universitary hospital	27	63	154	65	56	41	27	433
Pan Diamante Hospital	18	19	1	0	0	0	0	38
Health Station Pedrinhas	2	6	3	3	4	2	3	23
Sarah São Luís	0	0	0	0	0	1	0	1
Health Unit Coqueiro	3	2	1	0	0	1	2	9
Unit Jardim São Cristóvão	7	6	5	0	1	2	1	22
Health Unit São Bernardo	2	0	0	0	1	0	0	3
Health Unit Olímpica I	19	16	9	16	9	2	5	76
Health Unit Olímpica II	8	12	2	8	6	4	1	41
Health Unit Olímpica III	3	8	10	14	16	21	26	98
Health Unit Pirapora	7	3	6	4	1	0	1	22
Health Unit Santa Clara	13	14	9	10	9	13	0	68
Health Unit Santa Efigênia	10	9	12	2	1	3	6	43
Health Unit Vila Sarney	5	7	2	6	5	4	0	25
Mixed Unit São Bernardo	29	39	30	23	6	14	9	150
Mixed Unit Bequimão	31	31	30	23	24	11	10	160
Mixed Unit Coroadinho	45	48	26	19	13	7	0	158
Mixed Unit Itaqui-Bacanga	26	26	27	22	19	4	13	137
TOTAL	688	754	825	910	913	902	850	5842

Source: SES/MA/SINANNET/TABWIN [24]

The M.S. in its decree nº 3.125 of 10/2010, defines as case of abandonment, the patient who did not attend the health service in the last 12 months. Faulty Hansenians were those who had passed more than 9 months of treatment in Paucibacillary cases and over 18 months in Multibacillary cases (Table 5).

Table 5 - Abandonment of Hansen's Disease treatment at SINAM between 2008 and 2014

HEALTH UNIT	2008	2009	2010	2011	2012	2013	2014	Total
Health Center Amar	0	1	1	1	0	0	0	3
Health Center Bezerra de M.	2	2	1	0	1	0	1	7
Health Center Clodomir Pinheiro Costa	0	0	1	0	1	0	0	2
Health Center Cohab Anil	0	0	0	1	1	1	0	3
Health Center Vila Lobão	0	0	0	1	0	0	0	1
Health Center Fátima SAE	4	4	5	0	7	2	9	31
Health Center of Pedrinhas I	0	0	1	0	0	0	0	1
Health Center Djalma M.	1	0	3	0	1	0	1	6
Health Center of João Paulo	0	2	0	0	0	0	0	2

https://dx.doi.org/10.22161/ijaers.69.1 *ISSN: 2349-6495(P) | 2456-1908(O)*

Health Center Tibiri	0	0	2	0	1	1	0	4
Health Center Turú	1	3	3	0	1	0	2	10
Health Center Antonio G.	0	1	0	0	0	0	2	3
Health Center José Macieira	2	0	0	1	0	0	1	4
Health Center José Ribamar	0	1	0	0	0	0	0	1
Health Center Fabriciana M.	0	3	1	0	0	0	0	4
Health Center Genésio Filho	2	1	0	0	0	1	2	6
Health Center Genésio Rego	4	7	7	36	12	10	23	99
Health Center Janaína	0	2	0	0	1	0	0	3
Health Center João de Deus	1	0	0	0	0	0	0	1
Health Center Laura V.	0	0	0	0	0	0	1	1
Health Center Nazaré Neiva	1	2	1	2	2	0	0	8
Health Center Quebra Pote	0	1	0	0	0	0	0	1
Health Center Salamão F.	0	0	1	1	1	2	0	5
Health Center Santa Barbara	0	1	0	0	0	0	0	1
Health Center São Francisco	1	1	0	0	0	0	0	2
Health Center São Raimundo	1	2	0	0	0	0	0	3
Health Center Thalles G.	0	0	0	0	0	1	0	1
Health Center Vila Embratel	1	0	0	0	1	0	0	2
Health Center Vila Itamar	0	1	1	0	1	1	0	4
Health Center Vila Nova	1	1	0	0	0	0	0	2
Health Center Yvis Parga	0	1	0	1	0	0	0	2
Aquiles Lisboa Hospital	6	7	6	7	9	13	12	60
Aderson Sousa Hospital	0	2	1	1	2	0	0	6
UFMA Universitary Hospital	1	5	8	2	2	3	2	23
Pan Diamante Hospital	0	1	1	0	0	0	0	2
Health Stationof Pedrinhas	1	1	0	0	0	1	0	3
Health Unit Coqueiro	0	0	0	0	0	1	1	2
Health Unit São Cristóvão	1	2	0	0	0	0	0	3
Health Unit Olímpica I	1	2	1	2	2	0	0	8
Health Unit Olímpica II	0	1	0	0	1	0	0	2
Health Unit Olímpica III	1	1	2	5	1	4	6	20
Health Unit Pirapora	1	0	0	0	0	0	0	1
Health Unit Santa Clara	4	4	1	1	0	4	0	14
Health Unit Stª Efigênia	0	0	1	0	0	1	0	2
Health Unit da Família Vila Sarney	1	0	0	2	0	1	0	4
Mixed Unit São Bernardo	3	4	1	2	1	2	0	13
Mixed Unit Bequimão	1	0	2	0	2	0	1	6
Mixed Unit Coroadinho	1	2	0	1	0	0	0	4
Mixed Unit Itaqui-Bacanga	1	2	6	2	0	0	2	13
Total	384	308	339	285	302	267	244	2.129

Source: SES/MA/SINANNET/TABWIN [24]

The predominance of the diagnosis of multibacillary forms with 23,320 reported in Maranhão is similar to the study done by Amaral14 in which there was a predominance of multibacillary clinical forms - dimorfa and virchowiana - in relation to paucibacillary - indeterminate and tuberculoid. For Goulart et al. [15] this would be a sign that the diagnosis is late, helping to maintain the chain of transmission of the disease.

The form of the disease, as well as the proximity of the primary case, contributes to the risk of becoming ill. Extending the criteria of the contact condition beyond those domiciliares, the majority of the incident contacts could be related to a previous case of Hansen's Disease[16]. Hansen's Disease can target people of all ages, of both sexes. However, the involvement of children under 15 years is an indicator of high endemicity of the disease[17].

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In a study conducted by Camello[18], it was demonstrated that the use of intradomiciliary contact examination of the new cases detected and the follow-up of intradomiciliary contacts, detected in the last 10 years.

Regarding the breed, of the 60 (sixty) charts of patients analyzed at the Hospital, 53% of the patients were classified as brown, corresponding to 32 charts analyzed. There is no justification as to color / race, however, one may suggest that it is about ethnicity, with a greater predominance of brown color.

One of the main reasons for the worsening of the disease is the long incubation period, insidious evolution and prejudice, which can lead to death (Table 6).

Table 6 - Deaths of patients with Hansen's Disease

HEALTH UNIT	2008	2009	2010	2011	2012	2013	2014	Total
Health Center Amar	0	0	0	1	0	0	0	1
Health Center Clodomir	0	0	0	1	0	0	0	1
Health Center Fátima	0	1	0	1	0	1	1	4
Health Center Djalma M.	1	0	0	0	0	0	0	1
Health Center João P.	1	0	0	0	0	0	0	1
Health Center Turú	1	0	1	0	0	0	0	2
Health Center G.Filho	0	0	1	0	1	0	0	2
Health Center G. Rego	1	0	4	2	4	5	3	19
Health Center Salamão	1	0	0	1	0	0	0	2
Health Center Embratel	1	0	0	1	0	0	0	2
Aquiles Lisboa Hospital	1	1	2	0	0	2	2	8
Universitary hospital	1	1	2	0	0	0	0	4
Pan Diamante Hospital	1	0	0	0	0	0	0	1
Health Unit Olímpica II	0	0	0	0	1	0	0	1
Health Unit Olímpica III	0	0	0	0	0	1	2	3
Mixed Unit São Bernardo	0	1	0	0	0	1	0	2
Mixed Unit Bequimão	0	0	0	0	0	1	0	1
Mixed Unit Coroadinho	0	0	0	0	0	1	0	1
Mixed Unit Itaqui-Bacanga	0	1	1	0	1	0	0	3
TOTAL	**9**	**5**	**11**	**7**	**7**	**12**	**8**	**59**

Source: SES/MA/SINANNET/TABWIN [24]

As for schooling were cataloged from the 60 (sixty) medical records, illiteracy and incomplete primary schooling were more prevalent. Some charts did not contain information about schooling. The question of information and knowledge is an important factor to improve the disease, abandonment and lack of adherence to treatment, 62% of patients did not complete high school, characterizing 37 charts analyzed, these data confirm that Hansen's Disease comes over the years involving people with a less enlightened level, where the lack of education, considerably favors the evolution of the disease.

According to Neves et al. [19], low schooling is a problem that interferes with the understanding of the technical language used by professionals, leading to the compromise of information comprehension during the consultations. The individual monthly income of 41 patients was between 1 and 2 minimum wages, followed by 15 who had income of up to one salary and 4 who had income less than 1 minimum salary.

Age ranged from 20 to 72 years. It was evidenced that 73% of the population of this study are part of the economically active population (20-59 years), an important aspect, because Hansen's Disease is a disease that can cause disability, and may lead patients away from work, resulting in in economic losses [20].

Regarding marital status, 31 were married, 14 were single, 6 were divorced and 9 were widowers. This is related to the average age of the patients, since a large part of the population already has a family, so the impact of the disease discovery is significant[21] Regarding the occupation, the patients who were absent and / or abandoned had occupation, being 18 self-employed workers, 14 with employment, 11 were retired or were separated from their activities and 17 unemployed. According to information from SINAN, from 2008 to 2014, the new cases of Hansen's Disease reported at the

https://dx.doi.org/10.22161/ijaers.69.1 *ISSN: 2349-6495(P) | 2456-1908(O)*

AquilesLisboa Hospital are: Adherence to treatment at the AquilesLisboa Hospital from 2008 to 2013 has been increasing gradually, with a reduction in 2014, characterized by an increase of cases and / or more information to feed SINAN in 2013. The control programs also help considerably for people to seek the Hospital to perform the diagnosis and treatment.

When reporting difficulties in adhering to Hansen's Disease treatment, nurses participating in a study stated that there is no good patient adherence due to the lack of knowledge about the importance of treatment, the lack of clarity in the guidelines given to patients and also as a result of the drug reaction[5].

It was notorious that this picture of abandonment and / or resistance to treatment has been increasing, when analyzing the 60 (medical records), becoming a concern and that programs created by the government should minimize this. Regarding the cases of death in the abovementioned period considered small. Regarding the causes of adherence and abandonment (Table 7).

Table 7 - Data from the Aquiles Lisboa Hospital at SINAN, from 2008 to 2014

	2008	2009	2010	2011	2012	2013	2014	Total
Adhesion	56	70	81	85	122	193	168	775
Abandonment	6	7	6	7	9	13	12	60
Cured	37	60	55	59	75	131	101	518
Deaths	1	1	2	0	0	2	2	8

Source: SES/MA/SINANNET/TABWIN [24]

Adherence usually occurs with the help of family and friends, to attend a referral unit, which will perform the necessary tests to diagnose the disease, although, at the beginning, the patient may be confused with other pathologies, which only after consultation and examination are discarded other possibilities and, thus, will be referred to a multidisciplinary team that includes the social worker, so that the patient receives the first information about Hansen's Disease.

From the analysis of the medical records of the AquilesLisboa Hospital, a total of 775 cases of patients who started treatment between the years 2008 and 2014 were identified, of which 60 patients were reported to have missed or abandoned MDT treatment.

The patients' monthly income corresponds to the type of occupation and the educational level of the patients[22]. Low schooling and low income are risk factors for the development of Hansen's Disease, with an impact on quality of life, regarding social relations and acceptance of the disease[23].

The patients interviewed who live in Bonfim Colony, when asked about Hansen's Disease, 2 reported not knowing the information about the disease and 3 showed some knowledge. The interviewees referred to the disease associating the clinical picture and prejudice experienced, according to the words:

> This is a disease that stains our body and strikes the nerves. (patient number 1).
>
> It's an evil disease, no one's expecting it, and even if we take care of it, it still has sequels. (patient number 2).
>
> It is a dangerous disease, which agent is afraid of being close to others, which prevents the agent from working and still causes people who know that agent has the disease gets disgusted and afraid to get close to us, not to get the disease. (patient number 3).

In addition, the interviewees did not know the clinical form of acquired Hansen's Disease, and justified not remembering due to the language used by the professionals and the complicated nomenclature of the clinical form, nevertheless, they believed to have acquired the disease in the working environment or even in the street.

When questioned about the diagnosis of the disease, all said they had sought the health service due to the appearance of stains with numbness in the body, in addition to pain in the joints, in the hands and reported to feel burning in the body. The interviewees related signs and symptoms of Hansen's Disease demonstrating some knowledge about the signs and symptoms characteristic of the disease, which may be related to the media outreach campaigns.

In order to analyze the factors related to the absence or abandonment of the treatment, of the cases reported in the records, the intrinsic and extrinsic factors were divided, the motives mentioned to lack or to abandon the treatment of Hansen's Disease, the first was defined by arguments that explained the fact that they did not attend the health service only to seek medication and the desire to miss, and the extrinsic ones were characterized by justifications and situations that were independent of the patients' wishes and which constituted reasons to be absent.

https://dx.doi.org/10.22161/ijaers.69.1 ISSN: 2349-6495(P) | 2456-1908(O)

In the research it was verified that the extrinsic factors justified the total absence in multibacillary patients and represented 70% of the cases of abandonment in these patients. Among these factors, the side effects of the medication that according to the research resulted in one of the main causes of abandonment, among the medications, one of the most relevant was Thalidomide. In spite of the legal control of the medication by the MS since 1986, through ordinances, technical norms and publication of therapeutic and informative guides, in 2005/2006 three new occurrences were notified, comprising four births.

Still using this classification, the intrinsic factors corresponded to 30% of the cases, where it was highlighted the absence of symptoms and thoughts of not needing to follow the treatment, as well as the occurrence of other health problems such as: depression; hemolytic anemia; non-acceptance of the disease; religious cure thinking and constraint related to the monthly trips to the units to receive the medication as it was possible to verify in the interviewees' reports:

> I stopped because I was no longer able to take the medicine, I was full of pain, instead of getting better I felt worse (patient number 1).
>
> I asked for a cure for God and he healed me, and since I did not feel anything else, I stopped taking the medicine (patient number 2).
>
> I was not anymore because I was ashamed of others knowing that I was taking medicine for this disease, because I felt that the people they knew were avoiding being around me (patient number 3).

Because he does not receive adequate information, the patient supposes that from the reduction or disappearance of the symptoms that bother him, the use of the medication is no longer necessary. Side effects of medication is one of the main causes of neglect reported in the interview, where Social Care and Nursing professionals characterize as a factor that hinders the patient's return. This treatment is performed through Clofazimine, Dapsone, Prednisone, Rifampicin and Thalidomide, with effects being rejected by patients, who complain of joint pain, darkening of the skin, limb atrophy, onset of diabetes, hyperten- sion, depression and psychotic conditions .

Prejudice, the fear of the unknown, the fear of facing the reality of the diagnosis, the image society makes about the disease, the self-discrimination, the patient does not continue the treatment after diagnosis, leaves to "avoid" being seen in the unit of health, as fear of facing family and friends;

The difficulty of moving to the health unit in residents of municipalities distant from the place of treatment, without financial driving conditions;

Alcoholism in patients with problems of chemical dependence that do not give continuity to the treatment by force of the dependence that gives more "pleasure" than the force of seeking the cure of the disease.

The extrinsic factors were cited by 42 of the total of 60 cases reported in the medical records, patients as a reason for non-attendance to treatment, including: lack of medication in the unit; work out of the city and constant trips which made it difficult for the monthly trips to Unity.

A total of 33,308 cases of Hansen's Disease were reported in the System of Information and Diseases and Notifications (SINAN) from 2008 to 2014. In the total population of 33,308 people, 5,842 cases occurred in the city of São Luis and 60 (sixty) medical records at the Aquiles Lisbon Hospital.

In SINAN data, it was observed that the highest frequency of reported individuals was male, with 19,357 cases and aged between 20 and 34 years. In the analyzed records, a higher frequency of males was observed with 44 charts and only 16 females. As for schooling, both SINAN data, medical records, illiteracy and incomplete elementary schooling were the predominance among patients with Hansen's Disease.

In the period from 2008 to 2014, 775 patients' adherence to Hansen's Disease treatment at the AquilesLisboa Hospital were notified at SINAN, in which 60 patients abandoned treatment, 8 died and 518 were cured.

It should be stressed that cases of Hansen's Disease deserve more attention, not only because of the risk to society as a whole, but also because of the biological, social and economic repercussions that this disease causes, and it becomes a public health problem.

IV. CONCLUSION

The main reasons that influenced adherence were the campaigns with information inherent to the disease, family influence, more accessible means of communication, and increase of health posts with access to treatment, labor market requirements.

Regarding abandonment the main reasons were prejudice, lack of information, despite the diversification of information media, side effects of medication, which is one of the main causes of abandonment reported in the interview and in the accompanying newsletter.

The reasons given for not attending regularly to the Units were intrinsic and extrinsic, for the intrinsic ones stood out: the fact of not attending the health service only to seek medication and the desire to miss.

https://dx.doi.org/10.22161/ijaers.69.1 *ISSN: 2349-6495(P) | 2456-1908(O)*

As extrinsic factors were evidenced absence of symptoms; other health problems; non-acceptance of the disease; religious healing and constraint related to the monthly departures to the units and great relevance regarding the side effects of the medication, being one of the main causes of treatment abandonment.

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https://dx.doi.org/10.22161/ijaers.69.2 ISSN: 2349-6495(P) | 2456-1908(O)

Effects of Water Deficiency on Plants of *Acacia mangium* Willd

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***Abstract*—*The water deficit causes direct effects on the physiology of plants, affecting the biochemical reactions which results in reduction or stoppage of growth. The present study aimed to evaluate the influence of water deficit on gas exchange, water relations, accumulation of solute proline and activity of antioxidant enzymes in seedlings of Acacia mangium Willd., the statistical design was completely randomized design (DIC), represented by four water treatments (100; 60; 40 and 30% of field capacity) with 12 repetitions. Were evaluated at gas exchange ratio, leaf water potential, relative water content, activity of antioxidant enzymes, proline, and dry masses of leaves, stem, root and total. Gaseous Exchange in plants of Acacia mangium Willd., were influenced by reduced water availability in the soil. Treatment with 30% of field capacity presented greater accumulation of the amino acid proline content. There has been increased activity of antioxidant enzyme catalase in Acacia mangium Willd., in the treatment with 30% capacity field. In the production of dry matter to the most sensitive to water deficiency was the dry mass of leaves and stems, the treatments with 30% and 40% of field capacity.*
***Keywords*—*Proline, Climate change, Antioxidant enzymes, Dry*.**

I. INTRODUCTION

The species of *Acacia mangium* Willd, is one of Australian Acacias widely planted in many parts of the world, has clear benefits in agricultural ecosystems, forestry and agroforestry [1]. The main reasons for the widespread planting of *Acacia mangium* Willd., in mono cultures or in mixed plantations with other species of trees or crops in areas with infertile soil, are your ability to improve soil fertility [2, 3].

In the context of effects of climate change and their changes in ecosystems as low soil water availability, and the aver- age temperature increase on a global scale, are singled out as the main primary causes that can affect negative impact on the productivity of crops worldwide. These abiotic factors compromise and influence particularly physiological processes such as photosynthesis in relation to the use of primary resources such as water, light, temperature, CO_2 and nutrients and, consequently, growth rates [4].

The water deficit causes direct effects on the physiology of plants, affecting the biochemical reactions which results in reduction or stoppage of growth. On these facts, as with any initiative, many studies and research are required to have a minimum knowledge and consequent economic security of the FMU [5, 6].

The knowledge of species as their answers under the influence of different water conditions is essential, from the early months of growth, when the seedlings are highly susceptible to environmental variations [7]. Therefore, the present study aimed to evaluate the influence of water deficit on gas exchange, water relations, and accumulation of solute proline and activity of antioxidant enzymes in seedlings of *Acacia mangium* Willd.

II. MATERIAL AND METHODS

The experiment was conducted in a protected environment at the Experimental Station of the Federal University of Tocantins, Gurupi Campus, located in the southern region of the State of Tocantins, in altitude of 280 meters in 11° 44 ' 8 " South latitude and 49° 02 ' 58 "

https://dx.doi.org/10.22161/ijaers.69.2 *ISSN: 2349-6495(P) | 2456-1908(O)*

West longitude. The predominant climate in the region, according to Thornthwaite, is of the C2wA type "a", characterized by a wet sub humid climate, and precipitation between 1,600 to 1,700 mm and average annual temperature of 26° C [8].

The seedlings of *Acacia mangium* Willd., were from seeds collected in selected trees in the experimental field of the Federal University of Tocantins, Gurupi Campus. On the occasion of the installation of the experiment, seeds were subjected to treatment of breaking of dormancy with immersion in water heated to 100° C for 60 seconds. Sowing was done directly in cells with volumetric capacity of 290 cm ^{3}, where were sown three seeds per container with 60% of commercial substrate bioflora, 30% land of subsoil collected in Gurupi, TO 10% and sand. Mineral fertilizer coverage was held to 30 days after germination, using ammonium sulphate + 500 g 400 g of KCL/10000 cells [9]. After 25 days of sowing, the raleio, remaining only a change for cartridge, being that of greater force and better positioning in the container.

When the seedlings have filed approximately 150 days old, with about of 35 cm tall plants were selected uniforms which were transferred to polyethylene vessels with a capacity of 5.5 liters, filled with a mixture of 70% of the land of underground, 10% and 20% of commercial bioflora substrate. The soil collected belongs to the class average texture. The vessels were placed on metal benches of 3.0 x 1.20 x 1.0 m length, width and height, respectively with spacing between the vessels of 30 cm. The correction of acidity and soil nutrients used in the experiment was performed according to soil analysis and in accordance with the technical recommendations of the book fifth Approach [10] (table 1).

Table 1: Analysis of fertility of the substrate used in the experiment in pots in the greenhouse

pH $CaCl_2$	P	K^+	Ca^{+2}	Mg^{+2}	Al^{+3}	H+Al	B	Cu	Fe	Mn	Zn	C.O	M.O
	(mg/dm^3)	Macronutrients (cmolc/dm^3)					Micronutrients (mg/ dm^3)					dag.Kg	
5,6	11,6	0,28	2,0	1,0	0,0	1,50	0,1	0,4	11	0,7	0,5	1,2	2,0

During the acclimatization period of fifteen days in the greenhouse, all vessels were held at field capacity (100% CC). After this period the differentiation of water treatments: CC-field capacity, 60%, 40% and 30% of field capacity, according to the methodology proposed by [11] with a modification (added water on the surface of the substrate). The gravimetric method for the determination of direct CC was developed from four vessels, containing the equivalent of six kg of dry soil in the greenhouse. In the vessels, the deformed structure soil was moistened until saturation added water on the surface of the substrate after underwent drainage for a period of not less than 28 h, until the total cessation of free drainage, with the surface of the ground covered to avoid evaporation, opportunity in which determined the water content retained. The substrate retained 1.6 liters of water, which matched 100% of field capacity. This value plus the substrate dry weight (6 kg), was considered as control treatment (7, 6 kg). The other treatments were computed by the percentages laid down.

The surfaces of the vessels were covered with an opaque plastic, in order to prevent the loss of water by evaporation of the substrate. To maintain water levels established, the water lost by transpiration was reset every day through the weighing of experimental units (plant + pot + substrate) according to each level of water. To carry out this procedure, we used a scale with a capacity of 15 kg.

The statistical design was completely randomized design (DIC), represented by four water treatments (100; 60; 40 and 30% of field capacity) with 12 repetitions.

Leaf water potential (Ψf-MPa) was evaluated in two stages on day 6 and 25° days of the experiment in two times, on before tomorrow (5:00, Ψf-maximum-MPa) and noon (12:00, Ψf-minimum-MPa). For the determination of Ψf, were selected the leaves located in the middle third of the plant, and the equipment used was the Scholander pressure Chamber (SCHOLANDER et al., 1964).

Physiological characteristics evaluated were held daily, in the upper third of the plant, the fourth leaf fully expanded. Using the infrared gas analyzer (IRGA), LI-COR, model LI-6400XT (Portable Photosynhthesis System). The evaluations were carried out in the period of July 2017 and the measurements were carried out on the morning of the 09:00 ace 11:00 hours, using four plants per treatment. Simultaneously was registered the relative humidity (RH), air temperature (Tar) with the aid of a digital anemometer.

Gas exchange were measured at a CO_2 concentration of 360 mmol mol-1, temperature of 28° C and photosynthetically active saturated light radiation (PAR) of 1500 mmol m-2 s-1.

Has been evaluated, the internal carbon (Ci), net CO_2 assimilation, stomata conductance to water vapor (gs),

https://dx.doi.org/10.22161/ijaers.69.2 *ISSN: 2349-6495(P) | 2456-1908(O)*

transpiration rate (E), as well as calculate the efficiency of water use (EUA), obtained by the relationship between amount of CO_2 fixed by photosynthesis and amount of water transpired and carboxylation efficiency (A/CI).

For biochemical analyses, two collections of leaves, on day 6 and at the end of the experiment, constituting a total of 4 repetitions, packed in liquid nitrogen and stored in the -80 ultrafreezer° c. For subsequent determination of proline and enzyme activity of catalase, superoxide dismutase and ascorbate peroxidase.

The concentration of proline was evaluated by [12] . The activity of the enzyme's catalase, superoxide dismutase and ascorbate peroxidase were determined according to the methodologies adopted by [13] [14, 15], respectively.

The evaluations of dry pasta were measured at the end of the experiment in order to estimate the effects of the treatments on plant development, plants were separated in aerial part and roots, both parties were placed in paper bags, kept in an oven with air circulation (75 ± 2° C) until reaching constant weight. Then heavy in scale and semi-analytical were evaluated variables: accumulation of dry mass: of leaves (MSF), stem (MSC), roots (MSR) and total dry mass (MST).

The data of the variables leaf water potential (Ψf-MPa), relative water Content, activity of antioxidant enzymes, PROLINE and physiological were submitted to descriptive statistics and analysis of variance (ANOVA), and the means were compared by Tukey 5% level of probability using the SISVAR software program [16].
For air temperature variables (Tar), relative humidity (RH) averages were calculated and ±standard deviation.
For the calculation of average values and clothing of the graphs of gas exchange SigmaPlot software 10.0 was used.

III. RESULTS

During the trial period of twenty-five days inside the greenhouse the average values of relative humidity (RH) and air temperature (TEMP) along the experiment were 39.8% ± 7.6 and 32.7° C ± 3.0, with 57.2% ± 2.1 peak and 38.5° C ± 0.6 and minimum 27.1% ± 3.2 and 27.2° C ± 0.8 respectively.

The average rate values of stomata conductance (gs), net assimilation, transpiration rate (E), instant carboxylation efficiency (a/c) and water use efficiency (EUA) plants of *Acacia mangium* Willd., were reduced with decreased water availability in the soil, showing significant variations over time (Figure 1).

With respect to the variation in stomata conductance (gs) during the trial period, it is observed that plants under 100 and 60% of field capacity (CC) showed the highest values. However, the plants of treatments with 40 and 30% CC presented the lowest values of stomata conductance under water deficiency (Figure 1).

The plants submitted to hydric condition of 100 and 60% CC kept their stomata open over time, leading to greater consump- tion of water. However, plants under 40% of the CC variation presented the values of stomata conductance, over time, noting a decrease and a slight increase in the feeling of tolerance which reflects the exposure time of the plant under stress hydric. Treatment plants with 30% of field capacity were reduced stomata conductance by water deficit (Figure 1).

For net assimilation rate (A), the largest reductions were observed on water condition of 30 and 40% of the CC to the 5, 15 and 25 days of evaluating plants under 30% CC showed extremely low values, less than zero, suggesting the total outage CO_2 assimilation during this period (Figure 1).

On condition of 30% and 40% field capacity intercellular CO_2 concentration (Ci) was greater than in the control (100% CC), with a net assimilation rate on day 5 to zero both (30% and 40% CC) and at 15° and 25° for plants with 30% CC (Figure 1).In young plants of *Acacia mangium* Willd., observed a marked recovery rate of stomata conductance (gs), net assimilation, transpiration rate (E), carboxylation efficiency (a/c) and water use efficiency (EUA) for plants subject to the condition that 40% of the CC after the fifth day of water stress (Figure 1).

https://dx.doi.org/10.22161/ijaers.69.2 *ISSN: 2349-6495(P) | 2456-1908(O)*

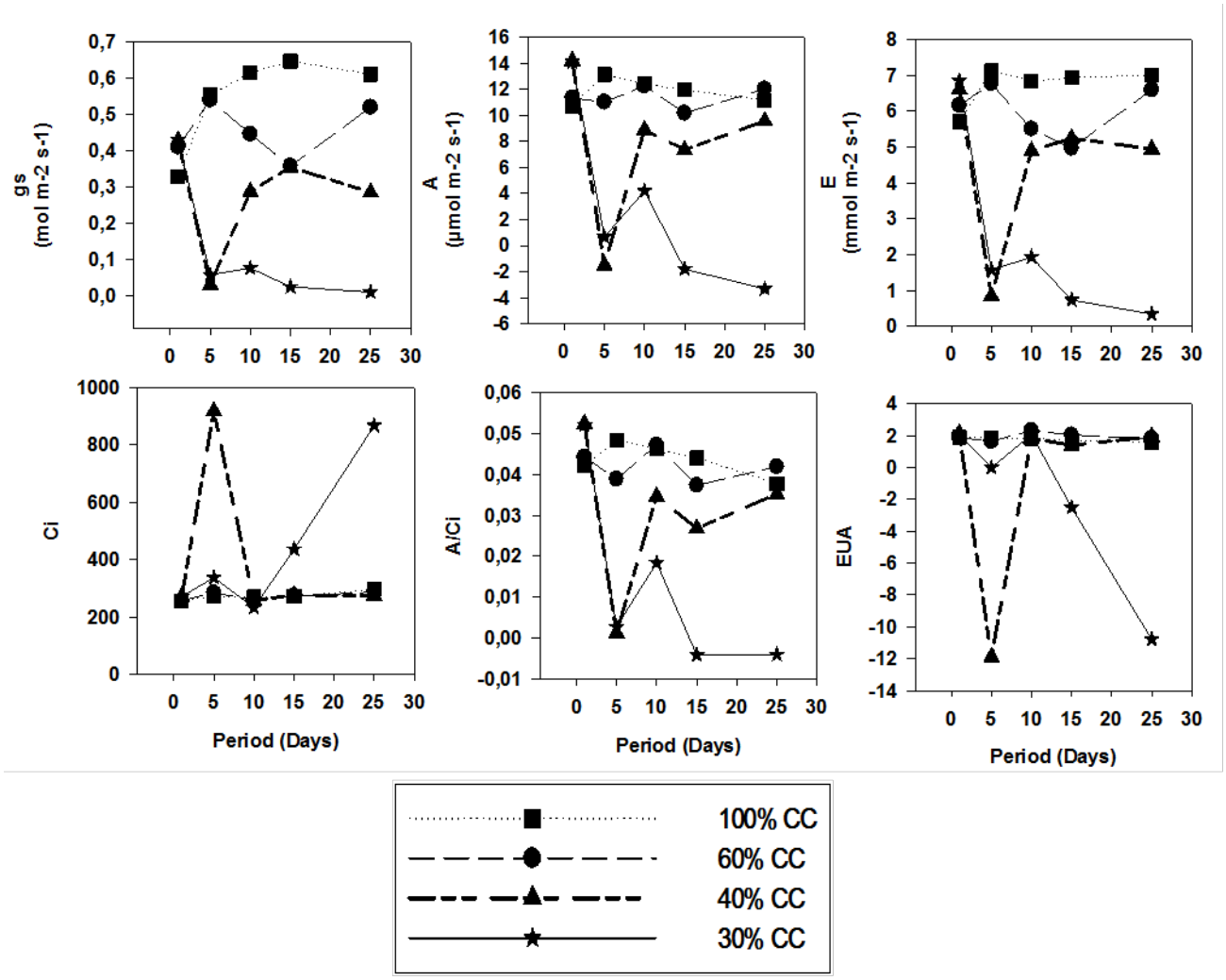

Fig. 1: Stomata conductance (gs), net CO_2assimilation rate (A), Transpiration (E), internal CO_2 Concentration(Ci), carboxylation efficiency (a/c) and water use efficiency (EUA) obtained in young plants of Acacia mangium Willd., subject to water deficit. Each point represents the average of eight determinations.

For the leaf water potential (Ψf-MPa) in *Acacia mangium* Willd., under water deficit at the time of initial evaluation during 5:00 and 12:00 treatment with 60% of field capacity showed no significant change in leaf water potential (Ψf-MPa) compared with plants to 100% of the CC, except for the potential measured at the end of the experiment at 12 hours (table 2 and 3).

Plants with 30 and 40% of the CC showed significant reductions in all seasons and times of evaluations, observing in the final period of the experiment in 5 hours and of the 12:00 a more pronounced decrease (-2.85 and-1.83 Mpa respectively) differed from the other treatments with plants under 60 and 100% of the CC (table 3). Noting that the plants under 30 and 40% of the CC were severely damaged by water deficit.

To 25° days of exposure to water stress plants of *Acacia mangium* Willd., under 100% and 60% CC on time of 5:00 in the morning, the plants under 100% and 60% of the CC presented significantly similar responses showing statistical difference between them. However, differ from plants under 40 and 30% of the CC. At the time of the 12:00, all treatments differed statistically among themselves (table 3).

https://dx.doi.org/10.22161/ijaers.69.2 *ISSN: 2349-6495(P) | 2456-1908(O)*

Table.2: Leaf water potential (Ψf-MPa) in young plants Acacia mangium Willd., under water deficit at the beginning of the experiment

Treatments (%CC)	Ψ (MPa) Start (5 Hours)	Ψ (MPa) Start (12 Hours)
100%	-0,15 a	-0,38 a
60%	-0,23 ab	-0,43 ab
40%	-0,28 bc	-0,60 ab
30%	-0,35 c	-0,65 b
CV (%)	14,11	16,40

* Medium followed by letters the same, do not differ statistically between them- selves by Tukey test (P < 0.05).

Table.3: Leaf water potential (Ψf-MPa) in young plants Acacia mangium Willd., under water deficit at the end of the experiment

Treatments (%CC)	Ψ (MPa) End (5 Hours)	Ψ (MPa) End (12 Hours)
100%	-0,30 a	-0,80 a
60%	-0,50 a	-1,30 b
40%	-0,93 b	-1,83 c
30%	-2,0 c	-2,85 d
CV (%)	8,87	3,88

* Medium followed by letters the same, do not differ statistically between themselves by Tukey test (P < 0.05).

The proline content to *Acacia mangium* Willd, followed the trend of increased up to 30% conditions of CC differing statistically from the other plants under water condition of 40, 60 and 100% of the CC (Figure 2).

The plants of *Acacia mangium* Willd, when subjected to a greater water stress (30% of field capacity) showed high activity of the enzyme catalase (CAT), being inhibited in witness with 100% of field capacity. Ascorbate peroxidase enzymes (APX) and the superoxide dismutase (SOD) activity remained similar to the control with the increase of water stress conditions. For this species the CAT was the main enzyme in combat the oxidative stress (Figure 2).

The water deficit in plants of *Acacia mangium* Willd., significantly decreased the production of leaf dry mass (MSF) and stem (MSC). Being the dry mass of leaves of the plant one of the variables most affected by the reduction of the water content in the substrate during the experiment, with the lowest value observed for plants under 30% of field capacity (17.74 g. plant-1) and higher for plants under 100% CC, (33.13 g. plant-1) these being statistically different among themselves (table 4).

To stem dry mass, greater value for plants under 100% CC (21.92 g. plant-1). Plants with 60% and 30% of field capacity showed intermediate values not statistically different from the other treatments (14.87 g. 1 plant and 16.07 g. plant-1 respectively). The lowest value was observed for treatment with 40% of field capacity (13.32 g. plant-1) (table 4).

How to root dry mass and total, the results showed no significant difference for the evaluated treatments (table 4).

Table 4: Dry mass (MS) leaf (F), (C) the stem, (R) and (T) total for seedlings of Acacia mangium Willd., under water deficit at the end of the experiment

Treatments (%CC)	MSF (g. plant -1)	MSC (g. plant-1)	MSR (g. plant-1)	MST (g. plant-1)
100%	33,13 a	21,92 a	29,19 a	84,25 a
60%	27,66 ab	14,87 ab	38,15 a	80,68 a
40%	23,11 bc	13,32 b	36,36 a	72,80 a
30%	17,74 c	16,07 ab	39,38 a	73,19 a
CV (%)	14,23	22,30	25,25	16,16

* Medium followed by letters the same, do not differ statistically between themselves by Tukey test (P < 0.05).

https://dx.doi.org/10.22161/ijaers.69.2 ISSN: 2349-6495(P) | 2456-1908(O)

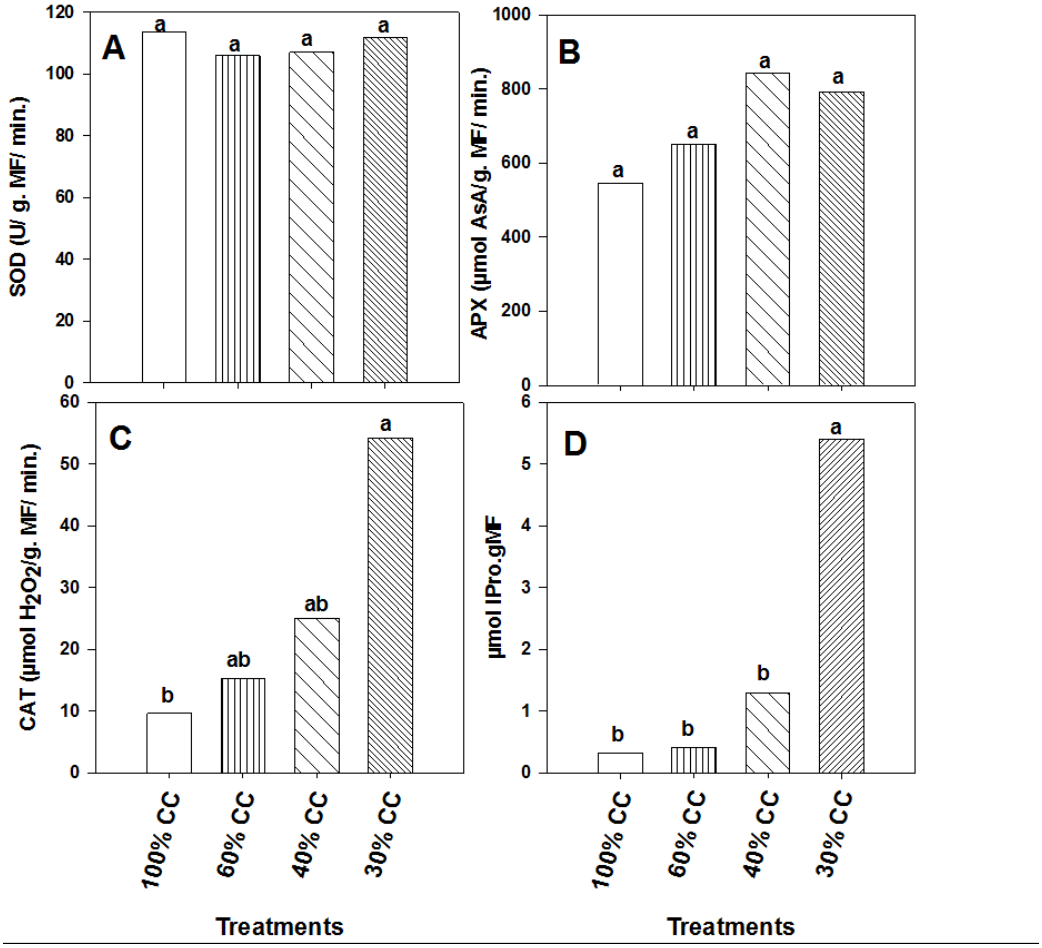

Fig. 2: Activity of antioxidant enzymes (A) superoxide (SOD), (B) peroxide of ascorbate (APX), (C), catalase (CAT), average values of the levels of proline (D) sheets of species of Acacia mangium Willd., under water deficit.

IV. DISCUSSION

The water deficit in the soil has caused metabolic changes in different species of plants [17, 18]. However, with the passage of time of exposure in water deficiency conditions, plants can develop certain tolerance while maintaining breath ability for longer periods. In this study it was observed that plants of *Acacia mangium* Willd., when subject to the condition that 40% of field capacity reflects that the affirmative (Figure 1).

It was observed that the closure of the stomata was the first factor of reduction in net assimilation (A), transpiration rate (E), instant carboxylation efficiency (a/c) and water use efficiency (EUA) plants of *Acacia mangium* Willd., under conditions of increased hydric deficit (30% and 40% of the CC). This reduction is due to the decrease in availability of CO_2 in the Chambers of sub estomatic leaves, caused by the closing of stomata (Figure 1) [19].

[20], in your work also noted the decrease in the values of stomata conductance in *Pterogyne nitens*, *Aspidosperma polyneuron* e *Myroxylum peruiferum* when subjected to different availability of water in the soil.

For water use efficiency (EUA) in plants of *Acacia mangium* Willd., it was observed that under conditions of 100%, 60% and 40% of the CC there was no large variations for the days 10, 15 and 25 days of experiment. Demonstrating a high efficiency and regulation of water use for treatment with 40% field capacity, this being the second most extreme water deficit condition (Figure 1).

The decrease in water use efficiency under the conditions of 30% of field capacity observed in 25 days of experiment can be due to the low availability of water found in the substrate and the time under this condition. Since the conditions of greater availability of water (100%, 60% and 40% field capacity) were not detected variations, observing the highest values (Figure 1).

The intercellular CO_2 concentration low (Ci) under the conditions of 30 and 40% field capacity, evidenced also with null net assimilation rate on some dates evaluated, can be assigned when the stomata conductance decreases, an increase of Ci can be detected. However, as the greater decrease occurs in relative water content, the

https://dx.doi.org/10.22161/ijaers.69.2 *ISSN: 2349-6495(P) | 2456-1908(O)*

CO_2 release photo respiratory source, this is from no photosynthetic fixation becomes relatively high, and a greater Ci can be verified.

Instant carboxylation efficiency (A/CI) in *Acacia mangium* Willd., along with the closing of stomata (gs), reducing transpiration (E) and net assimilation (A) and the decrease in the availability of water in the soil, reduce your status, by the fact of these plants possibly stop assimilate carbon, due to stomata limitation mainly on treatment with 30% of field capacity (Figure 1).

According to [21], water relations, the water stress acts directly in reduced leaf water potential (Ψf-MPa). Corroborating with this statement was evidenced in this study that the 30% CC plants showed significant reductions compared to other water conditions in all seasons and times of evaluations. Noting that the plants under 30% of field capacity has been severely affected by water deficit (table 3).

In this work at the end of the experiment on the 25th day under water stress to 30% of field capacity plants were severely hindered observing during 12:00 a reduction pronounced leaf water potential (-2.85 Mpa) plants differing in the too much water conditions (table 3).

The water stress can cause oxidative stress in plants, due to the increased production of reactive oxygen species (ROS), highly toxic in the living organism. The reactive oxygen species (ROS) as superoxide radical (O2 • –), hydrogen peroxide (H_2O_2) and the hydroxyl radical (OH •) cause damage to proteins and lipids of cell membranes of plants [22, 23].

To combat the production of ROS plants exhibit antioxidant mechanisms including antioxidant enzymes such as superoxide (SOD), ascorbate peroxidase (APX) and catalase (CAT) which prevent oxidative damage [24].

The lowest water availability of 30% of field capacity for seedlings of *Acacia mangium* Willd., caused this species needed antioxidant system, mainly of the enzyme catalase, due to your contribution to this condition. Given this, the probability of occur in cellular metabolism imbalance is high, induced by reactive oxygen species, mainly hydrogen peroxide which is found in high concentrations in plants under this environment.

Results that agreed with [25] that highlighted that the catalase enzyme was elimination of hydrogen peroxide more important for tolerance to stress. Increase in CAT activity under water deficit conditions was also observed in seedlings of *Copaifera langsdorffii* Desf. [7] e *Schinus terebinthifolius* Raddi. [21].

Many vegetables when subjected to abiotic stress change your metabolism. A compound that can be characterized as a drought tolerance factor for the plant is proline [26]. Proline accumulation in leaves of plants under water deficit conditions has osmoprotect function, acts as composed of carbon and nitrogen stocks during the water deficit, and as anti-oxidant [27].

In this study it was observed that the treatment with the highest water deficit with 30% of field capacity, presented the greater buildup of the amino acid proline content, noting that the water deficit increased statistically this solute concentrations compared to other plants under water stresses (Figure 2). So is regarded as one of the indicators that presents a strong relation to water deficit tolerance in plants of *Acacia mangium* Willd.

These results show that the coordinated action of the South and the enzyme catalase antioxidative proline responded better to face the harshest stresses applied.

The first visible effects of water deficit on plants of *Acacia mangium* Willd., were observed from the fifth day of stress with the appearance of dryness in the leaves (especially older), followed by leaf abscission mainly on treatment with 30% of field capacity.

In this study it was observed that the root development of plants subjected to higher degrees of water deficit (30% and 40% CC) was statistically similar to the control plants (100% of field capacity) and the area of the leaves and stems were statistically smaller for the treatments with higher degrees of water deficit with 30% and 40% field capacity respectively (table 4).

V. CONCLUSION

Gaseous Exchange in plants of *Acacia mangium* Willd., were influenced by reduced water availability in the soil. Treatment with 30% of field capacity presented greater accumulation of the amino acid proline content.

There has been increased activity of antioxidant enzyme catalase in *Acacia mangium* Willd., in the treatment with 30% capacity field.

On dry matter production in seedlings of *Acacia mangium* Willd., the more sensitive the water deficiency was the dry mass of leaves and stems in the treatments with 30% and 40% of field capacity.

The results showed that the *Acacia mangium* Willd., physiological and biochemical changes introduced in an attempt to tolerate the water deficit.

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https://dx.doi.org/10.22161/ijaers.69.3 *ISSN: 2349-6495(P) | 2456-1908(O)*

Informational Flow Mapping in Soybean Exportation Logistics Operation

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Abstract*— *Nowadays, Brazil is one of the largest soy producers in the world and, considering the great demand for this product abroad, an efficient logistic operation is necessary for the removal, transportation, storage and exportation of the grains. In this context, the informational flow mapping that there is in these processes is an important tool able to provide support for the development of strategies. With a case study conducted in a sector trading company in Paranaguá - PR (Brazil), it was possible to carry out a survey of the entire logistics process and map relevant information from the beginning of the process until its end, thus enabling the identification of the informational flow between the logistics department and the other sectors of the organization.

Keywords*— *Informational flow; Logistics; Information; Soybean; Exportation.

I. INTRODUCTION

According to the Brazilian Agricultural Research Corporation - EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária) (2018), in the 2017 to 2018 harvest period, the world soybean production was around 336.699 million tons, and Brazil was the second largest producer with a harvest of approximately 116.996 million tons, the first one was the United States with a production of around 119.518 million tons. And a study presented by the Federation of Industries of São Paulo State - FIESP (Federação das Indústrias do Estado de São Paulo) (2019), it is estimated that Brazil ranks first in the period of 2019/2020 with a production of approximately 123.000 million tons, ahead of the USA, which has a perspective of 112.900 million tons in this same period.

The largest world consumer of soybean is China, due to the large swine farming and poultry activity, and this country receives around the 60% of the traded grain in the world. About 70% of Brazilian soybean is exported to the Chinese market, becoming main trading partner of Brazil, it is more than 20% of the Brazilian international trade (DALL'AGNOL, 2016).

With all this worldwide demand for the product linked to the great productive capacity of Brazilian agriculture, the flow of the Brazilian soybean harvest depends on an efficient logistic performance. In order to fulfill this function with proficiency, the logistics department needs an efficient information management, because according to Carvalho *et al.* (2007), this contributes to operational control, planning and routine coordination, involving data from all company departments and also suppliers, customers and partners, as well as transportation, inventory control and product storage, disseminating information and enabling greater support for the company strategic management.

Given this scenario, this article presents the analysis of the informational flow of the logistics operation for soybean exportation carried out by a trading company, with a case study conducted in a multinational company that has been working in agribusiness for many years and has a large grain exportation capacity.

II. BUSINESS INFORMATION FLOW

Information management aims to support the management of the companies with processes that make information and its articulation in all areas more efficient and accessible, so that way the knowledge creation is favored. The strategic management of information has as its main point the integration among sources, information systems, receiver and sender of information, considering the objectives and purposes of the organization both internally and externally (LOPES, 2010).

https://dx.doi.org/10.22161/ijaers.69.3 ISSN: 2349-6495(P) | 2456-1908(O)

It turns out that for a company to be able to manage the information generated by its actions, it is necessary to know and to establish initially the existing information flow and what is better adapted to the company routines. For this flow to be established, it is need to map the existing information.

The informational flows may be formal or informal. In this sense, Lopes (2010) highlights that the formal flows have the origin in the company own structure, that is, routines and elements applied to the productive activities and may exist in registered and unregistered forms. The author points out that the information recorded goes through the formal systems of the company, "corporate portals, intranets, reports, records, documents containing rules and codes, among others." It is also pointed out that the information comes in unregistered form through "meetings, courses and events formalized but not registered in any form of support".

The informal flows, on the other hand, arise spontaneously, for example, through a meeting or even in conversations among the employees, being related to the intellectual structure of each individual who works in the company. It is important to say that these flows are usually an unregistered form because they are dialogues and non-formalized interactions among people and therefore not recorded in supports or systems (LOPES, 2010).

Valentim (2002) argues that it is possible to map these informal flows, just as it is possible to establish formal information flows, from the recognition of three environments. [...] The first one is linked to the organization chart, that is, the interrelationships among the different work units such as direction, managements, divisions, departments, sectors, sections etc.; the second one is related to the human resources structure, that is, the relations among people of the different work units and, the third and last one, is composed for the informational structure, that is, the generation of data, information and knowledge by the two previous environments (VALENTIM, 2002).

The existing information flows in the companies are naturally produced due to its activities and structural needs, that is, they are built by the individuals and areas from the activities, tasks and decisions that are being carried out (VALENTIM, 2010).

III. LOGISTICS FOR EXPORTATION

According to Pontes *et al*. (2009), the plantations are concentrated mainly in the Midwest and South of Brazil, with farms far from the main exporting ports, a situation that requires a great logistical structure to carry the grains from their origin to the destiny. It is important to highlight that all logistic infrastructure must be able to provide the distribution and storage of the crop, since the flow of the product is decisive and can affect agribusiness at its base, disrupting the operation, negotiation, pricing and even competition among the agents of the sector (OLIVEIRA, 2011).

Pais and Torres (2018) say that the most widely used mode of transportation for soybean harvest is the road one, with 47.6% of the production being transported by truck and 42.1% of the harvest being driven by trains and on a smaller scale, around 10%, across the country's rivers and lakes.

Brazil has more than 1.7 million kilometers of highways, which amplifies the use of roads, but 57% of this total has poor paving, according to a survey accomplished by the National Transport Confederation – CNT (Confederação Nacional de Transporte) (2018), which makes it one of the bottlenecks for the use of this type of transportation, being an obstacle to the lever of export logistics performance (FILASSI *et al*., 2017). Other factors that causes disadvantages were found, including the fact that the costs of this mode are higher compared to other modalities and the transported volume is smaller, which ends up causing grain spillage during the transportation and considerable damage at the end of the process. Another point to be mentioned is the formation of huge lines and congestion at the port terminals and roads. Finally, the greatest risk of accidents and thieves (BIZERRA *et al*., 2010; HIJJAR, 2004).

The intermodality is the transfer of the product from one mode of transportation to another, is an important outlet that has been used on an increasing scale in the recent years, as road transportation costs are higher than rail and waterway costs, it is natural that there is a substitution, and the trucks make the shortest route to a transhipment terminal, and the largest route is covered by trains or boats, ships (OJIMA, 2004).

According to Pontes *et al*. (2009), in addition to the transportation phase, the export logistics operations include the storage of the product and the performance at the ports. Regarding the origin, there are still few farms that have storage capacity for the product, which means that many producers have to transport the grain to a silo after harvest, generating a high cost.

As for the port terminal, many terminals have a reduced cargo storage and receiving capacity and require efficient control and planning in order to unload the

https://dx.doi.org/10.22161/ijaers.69.3 ISSN: 2349-6495(P) | 2456-1908(O)

trucks and wagons. They need updated inventory and shipment scheduling for an efficient operation (CAMARGO and CUNHA, 2012).

According to Milan *et al*. (2010), ports encompass the entire port community, that is, the authorities established for the port management, the cargo agents, the shipping terminals and all those who perform direct or indirect operations inherent to the port activity. In a general context it has evolved at every stage, from simple product loading and unloading points to exportation infrastructure corridors to absorb every operation of a crop, but they need to evolve further to meet all the demand in the industry.

IV. THE IMPORTANCE OF INFORMATION IN THE EXPORTATION LOGISTICS OPERATIONS

In the current scenario, an organization logistics department not only deals with product transportation, but also produces information that is extremely relevant to all operation, to the other sectors of the organization as well as for the base of the strategic planning that should have solid data. According to Fleury *et al*. (2000), the economic evolution has been changing the managers' view on logistics, considering it a strategic tool and a competitive advantage, and is no longer considered a simple operational activity.

Regarding the logistic-port operations for exportation, some information is essential for the success of the operation, whether related to the operational part of the service, removal of the cargo from the supplier, which mode of transportation is most indicated, the terminal that will receive the product, the time to take away the products and the transit time, and also those information related to payment of government taxes and charges, expenses with service providers, as well as data of the port, ship, climate and transmission line conditions, whether road or rail (SORDI, 2005).

According to Bessa and Carvalho (2005), for an efficient logistic performance, it is important to emphasize the need to present quality data that can be transformed into reliable, non-outdated, accurate, fast and secure information, thus it is vital that the logistics department is integrated with other sectors of the company with a good Information Technology tool, which are able to assist in the inventory control, the cost reduction, the operational agility (minimizing manual processes), the quality control and reporting, in order to improve the communication with internal and external partners and provide greater analytics capacity for threats and opportunities.

The lack of information, or its delay, and the problems generated in the logistics and port operations can directly impact in the product exportation process, it can lead to exponential costs and directly affect the end customer, and all agents that are part of the operation chain as ports, maritime agencies, warehouses, port authorities and governmental agencies that regulate international trade (SORDI, 2005).

Logistics comprises the planning activity, efficient transportation and the storage of products, as well as the information and associated activities, visualizing all the operation, from origin to destination, in order to satisfy the customer's needs. Thus, information technology and the data produced by it, become allies of the logistics operation that support the strategic definitions of organizations (SORDI, 2005).

V. METODOLOGY

This article was conducted as a case study, which, according to Jung (2004) is a research technique that analyzes a phenomenon inserted in a real scenario, especially when the boundaries between the phenomenon and the scenario are not evident. To collect the information, the observation method was used, which, according to May (2001), is the procedure in which the researcher interrelates, for a certain period of time, with the investigated in their routine activity, in order to technically understand the situation investigated.

V. CASE STUDY

6.1 Characterization of the studied company

It is a multinational company, with facilities in several countries, and one of the largest agribusiness companies in the world, exporter of commodities, also called trading. According to Carvalho e Caixeta Filho (2007), tradings are organizations responsible for the negotiation of the products with international clients, and also for the transportation, from the purchase of the products to the shipment.

The studied organization started its operations in Brazil just over 20 years ago and has more than three thousand employees, besides other activities, it works in the exportation of corn, wheat, bran, oils and has the soybean as the main product commercialized, using the several freight transportation modes and exporting throughout Brazil ports from north to south, operating a large logistics structure to take these products to world markets.

https://dx.doi.org/10.22161/ijaers.69.3 *ISSN: 2349-6495(P) | 2456-1908(O)*

The soybean handled by this organization in 2018, specifically in the port of Paranaguá, was around 687 thousand tons with the prospect of reaching one million tons in 2019 and growing even more in the coming years. According to the Administration of the Ports of Paranaguá and Antonina - APPA (Administração dos Portos de Paranaguá e Antonina) (2019), it is estimated that the Port of Paranaguá receives a volume of over 7.5 million tons of grains for unloading, and the soybean will be the main exported product with more than 4.7 million tons. The Porto of Paranaguá has a large operational capacity, joining its strategic location with one of the best port infrastructures in the Latin America, being the largest grain port on the continent and one of the largest port in general movement in Brazil, just getting behind the Port of Santos, in São Paulo and the Port of Itaguaí, in Rio de Janeiro.

6.2 Results

This paper aimed to map, from the perspective of information flow management, what are the main points inherent to the logistics processes within a company of the grains exportation sector, considering the beginning of the process, independent of the grain producer, until the end of logistic responsibility of delivering the product to the ship, pointing out the main strategic information related to each stage of the logistics process. In this sense, the presentation was categorized according to the logistic stage and its respective relevant information generated. It is also highlighted that it was considered both registered and unregistered information, and it was thus possible to identify the informational flow among the areas of the company.

The informational process of soybean exportation by the observed organization begins with the projection of the next harvest period. The company management makes a general mapping of the operation, with information gathered from all departments that participate in the soybean exportation process, such as logistics, inventory, controllership, trading and traders, gathering data from all operations and presents a market perspective for soybean handling volume. According to this study, it is organized the curve of the ships that will be made available and the operating costs with transportation, storage and purchase of the commodities. In possession of this information, the strategies for acting on soybean agribusiness and the volume to be exported by the Port of Paranaguá are defined, where logistics begins the informational and operational process of the grains flow, as follows.

The analysis of the results was categorized in the following order:

Category 1: Producer Output

Category 2: Transportation and the choice of modal

Category 3: Port Terminal

Category 4: Shipment Attendance

6.2.1 Category 1: Producer Output

At the moment of the product purchase is defined, in a contract, by the commercial department of the organization the information that will be passed to the logistics department about the local and the period of the cargo removal, the terminal where the products will be delivered and what will be the mode of freight. According to Maia (2007) the freight can be CIF (Cost, Insurance and Freight), where insurance and freight are contracted and settled by the supplier or FOB (Free On Board), where the products transportation, costs and risks are up to the buyer.

Freight mode information is essential for logistics, as it directly influences the way the department works; in the case of CIF freight, which corresponds to 30% of the volume, the logistics acts more in the control of information and deadlines, while in 70% of FOB freight, the logistics is responsible for conducting the entire operation, hiring single trucks to do the freight or using a road carrier and communicating by e-mail, passing all the necessary data for the product to be picked up and delivered according to the contract.

- The producer

The pickup locations, mostly, are from the Paraná State, around 80%, and also products produced in other states are purchased, such as São Paulo, Mato Grosso and Mato Grosso do Sul, according to APPA (2019), 72% of the soybean production exported by the Port of Paranaguá is produced by the State itself, another 10% come from Mato Grosso, 9% from Goiás, 3% from Mato Grosso Sul and around 2% come from Santa Catarina, São Paulo and other states. It is usually negotiated with producers or cooperatives that have been partners for several years, where the logistics department has knowledge of the farm location or warehouse where the soybean is stored and the route that will be used to transport the production, in the case of new suppliers, a survey is made on all information and registration in the company system.

- The product

Product quality assurance is essential, for this reason, a grading company is hired to analyze all purchased soybeans (ANEC standard 41), taking samples that identify the presence of impurities, moisture and broken

https://dx.doi.org/10.22161/ijaers.69.3 *ISSN: 2349-6495(P) | 2456-1908(O)*

grains, damaged or burnt. This information is extremely important, because if the product has been removed with good quality, it must be transported, unloaded and stored in a way that guarantees the properties of the soybean. According to Anes (2003), some factors are important to ensure the quality of the products, such as proper storage and transportation, temperature control and cargo aeration.

- The modal

The transportation is carried out according to the characteristics of the operation and regarding the deadline of the ship attendance. As the farms do not have a railroad to remove the product, the grains are removed by trucks, then around 70% of the soybeans purchased by the multinational company studied is destined to a transhipment terminal, to travel by train to the port terminal, and the other 30% goes directly by truck to the Port of Paranaguá. The definition of the mode of transportation should be based on the type of product to be transported, the place of removal, destination and costs may directly influence the final price of the goods (BAHIA *et al*., 2008). In this phase there is the alignment with the controllership and billing sectors of the organization, so that the products can transit with their respective notes, following the state and federal legislation.

- Deadline

The deadline for withdrawal of the product is defined in contract, but depending on the need, the logistics can speed this process to meet a ship that is about to dock or postpone for a period that does not compromise the pre-established time, because several factors are taken into consideration, such as the offering of wagons and trucks, availability of the destination terminal, delay or transfer of ships, moving to another terminal or port and non-ordinary situations such as strikes and stoppages.

- Climate issues

The visualization of the weather forecast is part of the daily logistics, as the rain can damage the product, so it is necessary to take all precautions when loading the product at the origin. Nowadays the silos where the soybean is deposited in the truck or the transhipment terminals (where they are placed in wagons), have cover and equipment to act in any weather condition, and also do not directly impact the transportation, since the product comes very well packed in the transportation mode which prevents the action of the weather, and if an incident occurs and the cargo is damaged or wet, it is verified in the classification of the destination and the responsibility for the misfortune is ascertained.

6.2.2 Category 2: Transportation and the choice of modal

- The rail modal

For the rail freight, an annual service contract is made with RUMO, the company responsible for transporting on the railway network in the Southern of Brazil, which has a minimum tonnage movement, what should be very well observed by logistics, in order not to have extra cost if the minimum production is not reached. If the minimum quantity cannot be reached, it may be compensated in the following months, and the logistics must make this control and find ways to compensate for this shortage, since the calculation and collection is done at the end of the year. For the cases where there is a sufficient time to make the batch, it is preferable to transport on wagons where the cost is lower and there is the need to comply with the contract.

- The road modal

As this multinational company does not have its own fleet of trucks, truck carriers are quoted and hired to pick up the product from the producer's place and drive to a transhipment terminal or directly to the port terminal. Some carriers have greater relationship with the company, which facilitates the negotiation and the operation, as they are used to the company working methods. At this stage the information collected by the logistics department on the costs and quantity of vehicles that will be made available becomes a great differential for the choice of the transportation company. The preference for this kind of modal is related to the shipments that have a certain urgency, because their delivery time at destination has been faster than rail.

- Costs

According to the organization, the value of rail freight is between 15% and 20% more advantageous than the highway freight, essential information for the definition of the organization strategic planning. According to Bizerra *et al*. (2010) it is necessary to interconnect the transportation, the intermodality, to take advantage of the potential of the road modal that has more flexible access, but with high cost for long journeys, and the rail modal that has lower cost for long distances, but with restricted access.

One of the difficulties faced by the logistics department is the issue of stays, which increases operation costs that harms the profit of the exportation operation, and it can be generated in both road and rail

https://dx.doi.org/10.22161/ijaers.69.3 *ISSN: 2349-6495(P) | 2456-1908(O)*

freight, due to the various logistical bottlenecks that exist in these transportation modals. In this way, delays in the unloading of the transported product become common, where the operational incapacity of the port terminals or the adversities of the harvest are very great, resulting in endless lines for the unloading of the transportation vehicles (JÚNIOR, 2017). Thus, it is up to the logistics department to effectively control the transit and waiting time of the trucks and wagons and to find ways to speed up the unloading process. This management is carried out through spreadsheet, information reports from the transportation companies and also through phone contact, seeking updated information in real time, which in the company studied has been very efficient, because the cases that generate stays are sporadic.

6.2.3 Category 3: Port Terminal

- The terminal choice

The choice of port terminal used some criteria, having some priorities, as it is a bonded place in the port primary zone, so the product is sent directly to the ship through the conveyor belts. The amount of fees charged per ton of soybean shipped; the available storage capacity; the rate of receipt of road and rail freight; the shipment capacity and the quality of service provided, are so priorities. This assessment was made by the logistics department and sent to the direction in order to evaluate with the other demands. In this case, the negotiation and formalization of a contract was authorized for 4 years.

-The reception of cargo by the terminal

For the terminal to receive the cargo that will be exported, it is necessary that the logistics department make the registration in the *Carga On-Line* system, which according to the Administration of the Ports of Paranaguá and Antonina - APPA, is an IT tool, which enables the scheduling and view, in real time, the number of wagons and trucks for unloading at Port of Paranaguá terminals, facilitating the access to the operational information such as: volume, traffic, unloading conditions and estimated forecast so that all the agents in the port chain are synchronized, to help in the transportation and logistics schedules of cargo, in order to organize the circulation of vehicles in the city and reduce the time spent in the port or the creation of trucks lines.

- Ship scheduling

The opening of quotas for registration in the system is conditioned to the ships scheduling, which are made after the announcement of each ship by the responsible Maritime Agency and following the chronological order of arrival, this information is followed by the multinational logistics through line-ups, usually provided by the Maritime Agencies, that have information about all the ships that will arrive at the Port of Paranaguá. And based on this information will start all the logistic planning of the shipment of the product at the origin, quantity required, the appropriate modal and the deadline for attending the named ship. It is also at this stage that the organization inventory department should be synchronized with the logistics, presenting the updated information of the balance available for exportation, something that is not always possible, because the products are stored in third party terminals and the studied company system is updated only once a day, then the logistics have to make a projection of the current inventory plus the trucks or wagons that were coming or in unloading process to match the available volume.

- Control of the port internal logistics

Every day, when it is necessary, it takes place at the APPA head office in Paranaguá, the mooring meeting, which is organized by the public company and it is attended by the employees of the trading companies, maritime agencies, port and terminals operators, in order to coordinate all the logistics-port process, defining the ship scheduling, what are the next to dock and the availability of the batches that each exporting company has to board on a particular ship, this last information is essential and needs to be confirmed by the organization logistics department along with the terminal, because if the exporting company does not have enough cargo to board in the ship, it needs to wait in line for the arrival of the product until closing the batch, and this waiting time may lead to a demurrage (kind of fine), which may reach US$ 25,000 a day of delay, according to Hijjar (2004) this over-stay is a fine paid by companies when there is some delays in the shipment of the ships, when it takes longer than what was formalized in the contract.

6.2.4 Category 4: Shipment Attendance

- Time of entrance and exit of the ship

The logistics department of the organization must be aware of the rules stipulated by the port authority for the line of ships, which today is with 18 ships and it has three modalities: normal, priority and super berth that according to APPA (2016) was recently created, and it allows the ship to dock at the port as soon as it arrives at the Paranaguá Bay, ahead of the other ones, but for this the ship has to fulfill some requirements, especially in completing the loading in a maximum time of 36 hours, in normal operations this period is of 48 hours, and every

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12 hours it is evaluated the productivity of shipment in order to verify that the operation is within the required parameters, and the logistics should assess the viability of this modality, because this agility represents a great gain for the company, but the non-compliance of some requirement can be very damaging.

With the ship scheduled at the mooring meeting, the logistics department transmits the information of quantity, terminal and mooring date to the trading administration sector, which processes the entire customs clearance and the release of the cargo for shipment to the APPA, Internal Revenue Service (IRS) and Ministry of Agriculture, Cattle Raising and Supply – MAPA (Ministério da Agricultura, Pecuária e Abastecimento, according to the Ministry of Infrastructure (2017) through the Paperless Port – PSP (Porto Sem Papel), there is greater agility in the logistics port processes and in the form of products customs clearance, this information system aims at gather in a single tool the information management and documentation necessary to speed up the analysis and the release of goods in Brazilian ports.

- Weather issues

At this stage of the process, the weather is a very important point to be assessed by the logistics department, as the shipment of soybean on the ship cannot occur with rain, because the rain may wet and damage the cargo; and in periods of heavy rainfall it may delay the ship line and implicate the logistical planning that was being carried out. Then it should be re-evaluated in order to not have lack of space to receive the cargo at the terminal and extra stays due to the delay.

- Quality control

In order to carry on the shipment, a supervising company is hired to take samples of the soybean, perform the analysis and certify the quality of the grain or any non-conformity, informing any discrepancy in the results; MAPA also conducts cargo surveys, analyzing whether there is the need for fumigation of the grains due to the presence of insects, where for some destinations, including China, this procedure is mandatory and this cost is paid by the exporting company.

- Shipment completion

With the scheduled quantity shipped on the ship, with the required quality and on the required time, the informational and operational logistic cycle of soybean for exportation ends, under the aspect of the logistics department of the studied company, from this point on the responsibility for the cargo and the delivery of the goods is by the ship charterer and the exporting company, at the end of the ship loading, it can make the presentation of the required shipping and negotiation documents, and thus receive the amount related to the product exportation.

6.3 Interdepartmental Information Flow

Every day the logistics sector holds a conference, called production meeting, where all the employees of this area participate, and all the ports that the studied multinational operates in Brazil and in the countries of South America, with the purpose of verifying the daily development of what was planned, to observe possible bottlenecks and to analyze any type of deficiency in the operations, in this way, a general mapping of the logistic processes is done and if something is impacting the grain flow process.

As IT tools, the company has its own programs, being at least three different software used, one for payment control and financial management, other for the operational part of vehicles and cargo handling, and the third one for inventory control and billing. But much information that the logistics department needs and makes available is tracked through spreadsheets that are fed from information collected from the partners systems or through reports received by email.

The informational flow that the logistics area has with the other sectors of the organization is extensive and needs agile and accurate information. Then it can be observed the main information released among the company areas, in order to accomplish the soybean exportation in a very efficient way.

Fig.1: Main information provided by logistics and received from other departments

Department	Provided Information	Received Information
Logistics X Juridical	All data from suppliers for analysis, scope of operation to be performed and trading data.	Contract with the supplier/ company that will be the service provider, clarification of contractual doubts and full legal instruction, giving support to the company so that it will not suffer future legal problems.

https://dx.doi.org/10.22161/ijaers.69.3 *ISSN: 2349-6495(P) | 2456-1908(O)*

Logistics X Commercial	Data on the negotiation with the port terminals and transhipments, as well as with the rail and road modals, exemplifying for the commercial area the possibility of the operation with their respective costs.	Scheduling of the volume that will be moved, with their respective deadlines by batches; Freight mode, quantity and place of withdrawal of the product, sale of ships (curve) with its monthly and annual schedule.
Logistics X Stock	Daily stock map and volume schedule to be moved daily, total cargo in transit, ship scheduling, completion of ships boarding to write off the stock.	Daily report of terminals and volume of products that is available for exportation, number of branches used to board the ship.
Logistics X Financial	Report describing the movement of the volumes with values, sending invoices for service provision for payment scheduling.	Request for approvals for expense payments, amounts paid, open payments.
Logistics X Billing	Instructions related to rail and road operations, aligning the procedure for issuing invoices for each type of transportation.	Synopsis and copies of invoices issued for tax coverage and attendance of cargo transportation.
Logistics X Trading Administration	Date of arrival and mooring of the ship (line up position); programming at a meeting with APPA; distribution of volumes and exporters by terminal; exchange information FOB, shipment completion and cargo shedding, if necessary.	Release of the documentary part of the ships for boarding with APPA and consenting agencies; instructions on how agents and operators should proceed in issuing shipping documents, any information that can affect the boarding of the ship.
Logistics X Controllership	Volume handled by the transhipments and port terminals, with their respective costs, scope of all operations, information for auditorship.	Analysis of how the operations are being performed in the financial part, ie., the planned and what was performed; and taxes, mainly related to taxes and taxes laws, accounting control and information that fully support the operation.
Logistics X Work Safety	Immediate reporting of any accident or incident occurred with employees or contractors; ensuring that instructions are sent to partner companies in order they to follow company safety standards, particularly related to transportation and defensive driving.	Safety information for operations; Accident and incident index, instructions for analyzing and avoiding all types of risk.
Logistics X IT Department	Reporting of system problems; software adequacy requests to fulfill the operations.	Clarification of doubts and treatment of systemic problems; digital security information.
Logistics X Company Direction	Possibilities of new business and volumes, for feasibility studies of the operation; operational costs of transportation and storage;	Authorization or not for the realization of the business and the operational design of how the project will be executed, the establishment of goals and support for the logistics department

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	prospection of new markets, products and partners, the progress of operations and whether targets are being met, comparative with other ports, performance of operations and process failures, as well as all the information needed to plan the strategy for action in the next harvest.	to have full autonomy in order to perform its functions.

Source: Authors (2019)

VI. CONCLUSION

After the analysis of the information obtained with the participative observation of the logistics department of the studied company, it was possible to identify all the informational flow that permeates the exportation process of the soybean commercialized by this multinational company, from the beginning of the logistic activity of product withdrawal from the farm to the end of the logistical responsibility of soybean delivery on board the ship.

Some information that is extremely relevant to the process, such as location and access to the producer, the quality of the product purchased, weather issues that may affect the product and delay the shipment time, the period of withdrawal and delivery of the product in the terminal, the kind of freight and the transportation modal and the costs that directly influence the strategic planning of the organization were highlighted. And related to the capacity of the shipping terminal and the accuracy of inventory control, as well as the compliance with port rules and ship scheduling analysis in order to avoid unnecessary spending and direct the logistics department work routine were also taking in consideration.

It can be observed the efficient management of informational flow throughout all the soybean exportation process, since all departments involved in the operation make direct and accurate communication through specific e-mail groups where each issue is directed to the respective responsible and also through shared folders, informative reports and the movement panel available at the local office in Paranaguá, transferring information that ensures the quality of the operation and reduces the risks inherent to the process, allowing the visualization of possible improvements in the operation and it also helps in the identification of failures that could hinder any step in the process.

It was possible to observe some inconsistencies in the IT tools that the organization has, since several information control softwares are used, which may complement each other, but it end up being very dispersed and need some dealings so that they can become relevant, and also, there is a lot of manually entered information in spreadsheets that are important to the operation but highly susceptible to mistakes. According to Bessa and Carvalho (2005), the information technology provides some advantages when integrated with logistics, such as support for operations, facility and agility in obtaining information, data reliability, providing greater basis for strategic definitions and decision making.

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https://dx.doi.org/10.22161/ijaers.69.4 ISSN: 2349-6495(P) | 2456-1908(O)

Image Deblurring Methodology using Wiener Filter & Genetic Algorithm

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Abstract— *The Blind Image Deconvolution/ Deblurring (BID) issue was acknowledged in the mid1960 yet despite everything it stays a difficult errand for the picture handling research network to locate an effective, solid and in particular a differently relevant deblurring plan.*

This exploration is centered on the improvement of rebuilding plans for genuine obscured pictures. The essential target is to structure a BID plan that is powerful in term of Point Spread Function (PSF) estimation, proficient as far as rebuilding speed, and viable as far as reclamation quality. An ideal plan will require a deblurring measure to go about as a criticism of value with respect to the deblurred picture and lead the estimation of the obscuring PSF. The obscured picture and the assessed PSF would then be able to be passed on to any traditional reclamation channel for deblurring.

The deblurring measures exhibited in this exploration incorporate visually impaired non-Gaussianity measures just as visually impaired Image Quality Measures (IQMs). These measures are visually impaired as in they can check the nature of a picture straightforwardly from it iii without the need to reference a brilliant picture. The non-Gaussianity measures incorporate spatial and phantom kurtosis measures; while the picture quality analyzers incorporate the Blind/Reference-less Image Spatial Quality Evaluator (BRISQUE), Natural Image Quality Evaluator (NIQE) record and Re-obscuring based Peak Signal to Noise Ratio (RPSNR) measure. Likewise, parametric and self-assertively molded (non-parametric or conventional) PSFs were treated for the visually impaired deconvolution of pictures. Full-reference and non-reference IQMs have been used to check the nature of deblurred pictures for the BID plans.

The essentialness of the examination work lies in the BID plan's capacity to deal with parametric and self-assertively molded PSFs utilizing a solitary calculation, for single-shot obscured pictures, with improved streamlining through GA related to different input IQMs.

Keywords*— *Image Deblurring, Wiener Filter, Genetic Algorithm.

I. INTRODUCTION

Image Blurring has become a serious point of concern with the advancement of technologies. Such issues arise from various sources such as handheld cameras, mobile camera, CCTV, satellite sources, sometimes from other sources as well. The process of capturing plays a vital role in quality of any image. If recorded with imperfections, this leads into several issues later on while processing such images to obtain relevant information out of them. These issues are mainly occurring because of lens defocusing, improper lighting. The use of handheld cameras, especially by amateur photographers, has resulted in blurred images caused mostly from camera shake or improper focus of camera lens. Some examples of such blurred images are shown in Fig.

Fig 1: Example of Realistic Blurred Images

https://dx.doi.org/10.22161/ijaers.69.4 ISSN: 2349-6495(P) | 2456-1908(O)

Furthermore, noise may corrupt any captured image. Noise may appear due to the inability of the models to estimate the imaging data perfectly and is regarded as deblurring noise. Apart from noise, ringing may occur in the restored image due to the imperfect estimation of blur. Ringing occurs for a restoration filter if it assumes the image's frequency sample is periodic which leads to high frequency drop-off at the image boundaries. Removing or correcting such issues of imperfections, becomes very important when it comes about Image Processing or may be Signal Processing**.**

II. LITERATURE SURVEY

The literature survey reveals that a lot of work has been done for Image Deblurring. During processing framework many points are not touched. In this work such points are covered which have not been considered by the researchers in the past with the following objectives:

- To identify the major challenges in Image Deblurring.
- To propose a method for reducing computation time and increasing accuracy.
- To provide more relevant results

1. **Chengtao Cai, An Liu, Baolu Zhang [2016]** proposed a Motion Image Deblurring System with Wiener Filter Algorithm. The key methodology in the framework was to examine the range of the Fourier change to assess the point spread capacity of the obscured picture and reestablish the picture in victor channel. In Wiener channel calculation, distinctive parameter has diverse impact on the picture and the impact of different parameters were recorded and broke down by them. The wiener filter was proposed as simple, efficient and good influencing algorithm for image restoration. The major concern with approach is the degradation of image quality after restoration of image.

2. **Yuquan Xu, Xiyuan Hu, Silong Peng [2015]**, proposed a Blind movement deblurring utilizing optical stream model. This work underscored on two sort of movement obscure, including Camera Shake and moving items. The real commitments were including the reconciliation of the scene that has experienced a relative movement depicted by a grouping of optical stream fields. Likewise, they determined the optical stream estimation calculation to help gauge the non-uniform PSF for every pixel. Various constraints were applied on the images to obtain good results in different conditions. The speed of execution was a major concern in the work.

3. **F.Alaoui, A. Ghlaifan Abdo Saleh, V.Dembele, A.Nassim [2014]**, proposed a paper on Application of Blind Deblurring Algorithm for Face Biometric. The key areas of concern were deblurring of motion blurred images during face biometric using blind deblurring techniques. Sparse Kernel Estimation using Salient Edge Prediction, Estimation of Blur Kernel and ISD based Kernel Refinement was done and finally a Fast TV 11 Deconvolution was performed. Euclidean distance was calculated to obtain the difference between original and motion blurred images as performance evaluation. The major drawback of this work was related to non-linear motion blurred images (the variation of both direction and size of blur).

4. **C. Y. Zhou, S. Lin, and S. K. Nayar, [2011]**, proposed a paper on Coded Aperture Pairs for Depth from Defocus and Defocus Deblurring, expressing that, the traditional way to deal with profundity from defocus (DFD) utilizes focal points with round openings for picture catching. The utilization of a round opening seriously limits the precision of DFD was appeared. The basis for assessing a couple of openings as for the exactness of profundity recuperation was determined in it. This basis is upgraded utilizing a hereditary calculation and angle plunge search to touch base at a couple of High-goals openings. These two coded openings are found to supplement each other in the scene frequencies they safeguard. This property empowers them to recuperate profundity with more noteworthy loyalty as well as get a superb all engaged picture from the two caught pictures. Broad reproductions just as tests on an assortment of genuine scenes exhibit the advantages of utilizing the coded openings over traditional roundabout gaps.

5. **Aftab Khan, Hujun Yin, [2018],**proposed paper on Parametric visually impaired picture deblurring with inclination based unearthly kurtosis expansion expressing, A steepest plunge streamlining plan is utilized to enhance the haze parameter toward most extreme supreme kurtosis of the deblurred picture. The proposed technique works on single picture and is straightforward, effective and simple to execute. The strategy is relevant to different kinds of foggy spots, for example, Gaussian, movement and out-of-center. Examinations on both counterfeit and genuine obscured pictures have demonstrated the capacity and checked improvement of the plan over the current

https://dx.doi.org/10.22161/ijaers.69.4 ISSN: 2349-6495(P) | 2456-1908(O)

techniques, as far as both visual recognition and a scope of value measures.

6. **R. Raskar, A. Agrawal, and J. Tumblin [2006],**introduced paper on Coded Exposure Photography: Motion Deblurring Using Fluttered Shutter. In an ordinary single-presentation photo, moving items or moving cameras cause movement obscure. The introduction time characterizes a fleeting box channel that spreads the moving item over the picture by convolution. They show that physically determined point spread capacities are adequate for a few testing instances of movement obscure evacuation including incredibly enormous movements, finished foundations and fractional occludes.
7. **O. Whyte [2012]**, in paper titled as, Non-uniform Deblurring for Shaken Images, expressed that, Photographs taken in low-light conditions are regularly hazy because of camera shake, for example a movement of the camera while its shade is open. Most existing deblurring techniques model the watched foggy picture as the convolution of a sharp picture with a uniform haze part. This model can catch non-uniform haze in a picture because of camera shake utilizing a solitary worldwide descriptor, and can be substituted into existing deblurring calculations with just little adjustments. To show its viability, it was connected this model to two deblurring issues; first, the situation where a solitary foggy picture is accessible, for which we look at both an estimated minimization approach and a most extreme a posteriori approach, and second, the situation where a sharp however boisterous picture of the scene is accessible notwithstanding the hazy picture. Makes it conceivable to display and evacuate a more extensive class of hazy spots than past methodologies, including uniform haze as an exceptional case, and exhibit its adequacy with tests on engineered and genuine pictures.

III. RESEARCH METHODOLOGY

The field of BID spans over a period of four decades and has applications in diverse fields. A wide range of mathematical and image processing techniques were used to tackle this. This section is committed to place a look at some essential ideas in the field of BID. The Degradation Model, Types of Blurs, and a Filters of Restorations are discussed. Some of the existing techniques are also discussed to compare the current research work.

Problem Formulation

Accepting picture rebuilding process as a straight framework, a caught picture is the yield of the convolution of the spatial drive reaction otherwise called Point Spread Function (PSF) of the direct obscuring framework with the first picture (scene).

Give *m* and *n* a chance to be the spatial picture directions and *f* present the first picture with no type of corruption, *h* be the PSF and the yield of the framework be given by *g*. Scientifically, for a stationary impulse response of the system over the picture (for example a spatially invariant stationary PSF), the discrete type of the convolution is given by [46, 47],

$$g = h * f + v \quad (3.1)$$

where * represents the 2-D convolution operator and v represents additive noise. The frequency domain model obtained using the Fourier Transform is,

$$G = HF + V \quad (3.2)$$

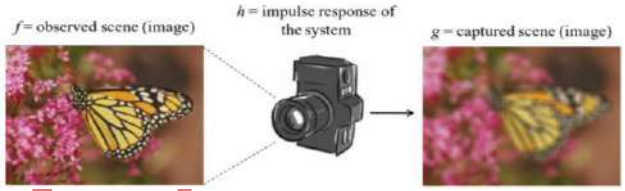

Fig.3.1 Image blurring model of a camera

The objective of deblurring is to deliver a decent estimation of the first picture *f'*. This procedure is commonly known as convolution sifting or deconvolution [46] and deblurring on account of the rebuilding of obscured pictures.

In the commotion free case, having earlier learning of the PSF *H*, Eqn. 3.3 can be utilized to discover *F'*, an estimate of *F*, by,

$$F' = H^{-1} G \quad (3.3)$$

such that,

$$F' = F \quad (3.4)$$

This is known as opposite sifting [48]. On the off chance that the careful parameters for the tangling sign are known, it is sensibly expected that the first sign can be recouped precisely.

Likewise, if the Fourier change of the PSF contains zeros, the backwards separating turns into a poor reclamation strategy. This situation of deconvolution of the two sign when both are obscure is named 'blind deconvolution'.Stockham *et al. in* [49] were the first to coin the term for this problem.

Restoration Filters

The following section introduces the reader to some of the classical restoration filters that were used or studied in this research work.

https://dx.doi.org/10.22161/ijaers.69.4 *ISSN: 2349-6495(P) | 2456-1908(O)*

Inverse Filtering

The most optimistic way to deal with deblur any picture is, evaluating the reverse of the PSF that obscured the picture and apply it to the obscured picture and recuperate the first picture. For a silent obscured picture case, the immediate reverse separating can without much of a stretch be connected in the ghastly (recurrence) space [48], since the convolution procedure will be changed over into increase. The inverse filtering procedure can be spoken to as:

$$F' = \frac{G}{H} \quad (3.8)$$

Much of the time the obscuring PSF isn't accessible particularly for genuine obscured pictures which prompts the genuine issues.

Wiener Filtering

As inverse filtering is very sensitive to additive noise which gets amplified during this process, a simple approach is to reduce single degradation at a time. The Wiener filtering is a estimating the image linearly. This is a stochastic framework based approach which can be given mathematically as:

$$F' = \left[\frac{H^*}{|H|^2+\delta}\right] \; where \; \delta = \frac{|V|^2}{|F|^2} \quad (3.9)$$

The Wiener filtering executes an optimal trade off between inverse filtering and noise smoothing [61]. The additive noise is removed and so as the blurring is inverted simultaneously. The Wiener filtering is optimal in terms of the Mean Squared Error (MSE) [48].

Iterative Blind Deconvolution Method

IBD uses frequency domain by Fast Fourier Transform (FFT) and some of deterministic constraints in the form of non-negativity and finite support constraints. The algorithm is shown in Fig. 3.6 [29, 32, 62].

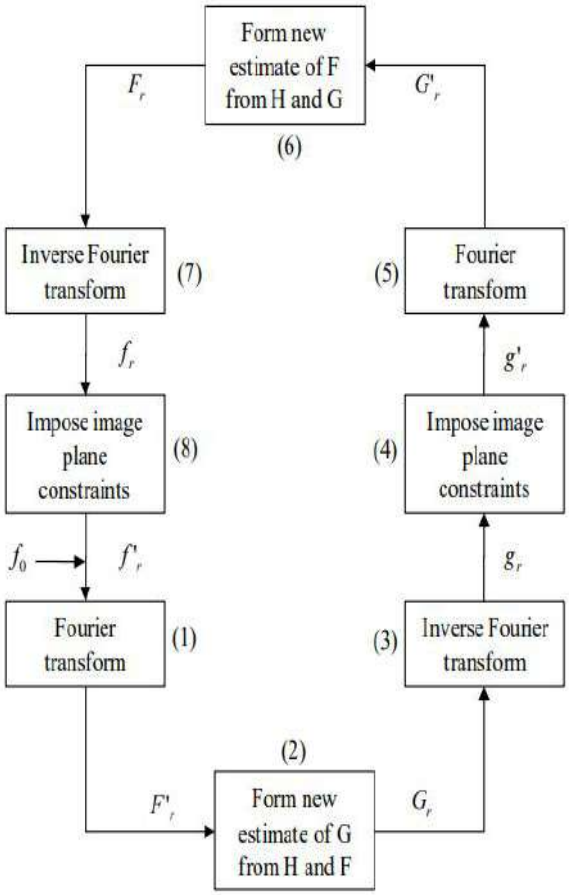

Fig 3.2 Block Diagram of Iterative Blind Deconvolution (IBD) algorithm

The IBD technique is well known due to its low intricacy [29, 32]. Another favorable position of this system is its strength to clamor which results from the poorly presented nature of the visually impaired picture deconvolution issue. In any case, the reverse channel is hard to characterize all over the place. IBD calculation additionally experiences questionable uniqueness, intermingling, precariousness and affectability to starting picture gauge [62].

Richardson-Lucy Algorithm

Richardson presented an iterative method of restoring degraded images in [27] based on Bays' theorem of conditional probability, by considering the image, PSF and degraded image probability functions. For an original image *F*, the PSF *H*, the degraded image presented by *G*, and the iteration *k*, Bays' theorem may be employed as follows

$$P(F|G_k) = \frac{P(G_k|F)P(F)}{\sum_{i,j} P(G_k|F)P(F)} \quad (3.10)$$

Also considering G_k with respect to its dependence on *F*

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$P(F) = \sum_{i,j} P(FG_k) = \sum_{i,j} P(F|G_k)P(G_k)$

(3.11)

and

$P(F|G_k) = P(F|G_k)/P(G_k)$

(3.12)

Substituting Eqn. 3.10 in Eqn. 3.11, we get

$$P(F) = \sum_{i,j} \frac{P(G_k|F)P(F)}{\sum_{i,j} P(G_k|F)P(F)} P(G_k)$$

(3.13)

$$P(F) = P(F) \sum_{k} \frac{P(G_k|F)P(G_k)}{\sum_{i,j} P(G_k|F)P(F)}$$

(3.14)

The fundamental issue of blind Richardson-Lucy calculation is that it needs an underlying theory for the help size of blurring kernel. In spite of the fact that the blurring kernel is joined in the square circulate network structure, the help size must be either known or assessed, hence making the calculation non-blind.

Regularization Based Deblurring Algorithm

Investigating the convolution model of obscuring displayed in Eqn. 3.2, the picture gauge through opposite separating is given by Eqn. 3.15 as pursues

$$F' = \frac{G}{H} = F + \frac{V}{H}$$

(3.15)

The rebuilding error for this model is given by Eqn. 3.16

$$\|F' - F\| = \left\|\frac{V}{H}\right\| = \sqrt{\left|\frac{V}{H}\right|^2}$$

(3.16)

Because of the not well presented reverse issue, the reclamation mistake will take enormous qualities, especially enhancing the high recurrence clamor [64]. Because of this issue, the framework characterized in Eqn. 3.19 yields arrangements at focuses where the intensified high recurrence commotion veils the ideal arrangement *F*.

Full-Reference IQMs

For BID, quality measures have been created to assess the viability of individual plans or to assess diverse picture preparing calculations. In mistake based execution assessments, the reclamation is assessed by estimating the measure of progress in picture quality. To quantify that improvement, one needs the first, the twisted and the reestablished pictures accessible in the estimating procedure. Degree of rebuilding execution can by and large be viewed as a procedure that takes in the first picture *f*, the mutilated picture g and the reestablished picture *f'* and restores a scalar worth. This yield worth is subsequently a measure to demonstrate how much the picture quality has been improved from the obscured picture *g* to the reestablished picture *f'* as for the first picture *f*. Recorded beneath are the variations of the mistake based execution measures, these measures are as yet utilized and in actuality most of the picture handling plans base their quality execution on these measures [81]. This is basically in light of the fact that these measures are anything but difficult to utilize and promptly give a numerical incentive to coordinate.

Peak Signal to Noise Ratio (PSNR)

Assessing deblurred picture quality requires a measure. MSE is an in all respects generally utilized quantitative measure in the sign and picture preparing network [48]. PSNR gives quantitative picture quality outcomes by scaling the MSE as indicated by the picture extend. For grayscale pictures with a pixel force run from 0 to 255, the PSNR is characterized as,

$$PSNR = -10\log_{10}\left(\frac{\sum_{m=1}^{N}\sum_{n=1}^{M}(f(m,n) - g(m,n))^2}{255^2}\right) dB$$

(3.17)

PSNR is estimated in decibels (dBs). A higher estimation of PSNR speaks to a picture of high caliber. The PSNR isn't favored in light of the fact that the evaluated sign quality is taken as most extreme sign worth, instead of the genuine sign quality for the picture.

Mean Structural SI Milarity Index (MSSIM)

It measures the structural similarity between two images by comparing the intensiy patterns of locally pixels which are normalized for luminance and contrast. For two images *f* and *g* SSIM is given as.

$$S(f,g) = t(l(f,g), c(f,g), s(f,g))$$

(3.18)

$$l(f,g) = \frac{2\mu_f\mu_g + C1}{\mu_f^2 + \mu_g^2 + C1}$$

(3.19)

$$c(f,g) = \frac{2\sigma_f\sigma_g + C2}{\sigma_f^2 + \sigma_g^2 + C2}$$

(3.20)

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$$s(f,g)=\frac{\sigma_{fg}+C3}{\sigma_f\sigma_g+C3}$$

(3.21)

Whereμ = mean,σ = standard deviation of the images with constants$C1,C2,C3$. The major applications of SSIM are in denoising and classification [82, 83]. MSSIM must be higher in value to have higher quality of results.

Universal Quality Index (UQI)

It analyses the loss in correlation, luminance and contrast distortion keeping the base for quality among the two images. The UQI for two image signals f and g is defined in Eqn. 3.22 as,

$$Q(f,g)=\frac{4\sigma_{fg}\mu_f\mu_g}{(\sigma_f^2+\sigma_g^2)(\mu_f^2+\mu_g^2)}$$

(3.22)

Rearranging Eqn. 3.22 we obtain,

$$Q(f,g)=\frac{\sigma_{fg}}{\sigma_f\sigma_g}.\frac{2\mu_f\mu_g}{\mu_f^2+\mu_g^2}.\frac{2\sigma_f\sigma_g}{\sigma_f^2+\sigma_g^2}$$

(3.23)

The first term is the correlation coefficient of the two signals, whereas the secondhand third terms measure mean luminance and structural similarity. A higher estimation of UQI speaks to a picture of high caliber.

Non-Reference IQMs

IQMs have been high point of interest in image processing for blind evaluation of image quality. Two of the IQMs used in this research work are BRISQUE and NIQE. The other two IQMs, spatial and spectral kurtosis, are based on higher order data. Main advantage of such IQMs is that not only are they independent of reference image and features associated with distortion (i.e. ringing, noise, blur, or blocking). They have shown to compete well with top performing non-reference image quality analyzers trained on human judgments of known distorted images.

Non-Gaussianity as a Quality Measure

Conventional image performance measures work on the principle of subjective (qualitative) performance measures or quantitative quality measures which are based on error/difference image. These conventional measures, both subjective and error based, tend to have their own pros and cons. Even a combination of subjective and error based objective measures, like HVS based performance systems, fall short inapplicability, simply because of the very complex nature, limited knowledge and implementation difficulties of human eye behavior. These error based techniques are dependent on relational matching between two images; the observed and the reference. Therefore, relational based performance evaluation techniques require reference image in addition to the observed and the restored image, which may not be available in any real life scenario, like digital camera photography. Hence, these performance indices cannot be used as a performance maximization criterion or act as a feedback parameter.

The obvious question of how it works can be answered as follows: the information content of a noise free and undistorted image is unique which does not remain the same when it is subjected to any degrading or distortion function. Hence, when any blurred image is treated by any deblurring algorithm, all it tries to do to bring the blurred image to its pristine form is to eradicate the distortions. From the perspective of the blurred image's information content or the space of non-Gaussianity, this algo attempts to regain original information or to nonGaussianity, which otherwise happens to be at its minimum when it is blurred. Thus non-Gaussianity of the data can be employed as a performance measure, with or without the need of the original image as required by other measures, where it conserves as a feedback performance measure for the BID scheme. The quality index for comparing the performance of improvement/deterioration of any image can then be defined as,

$$Q_{NG}=\begin{cases}\frac{J_o}{J_1} & if\ \ J_1\geq J_o\\ \frac{J_1}{J_0} & otherwise\end{cases}$$

(3.24)

Where, J1 and JO, are non-Gaussianity of the original and the distorted image respectively. The advantage of using a non-Gaussianity based performance measure is not only that it works for both blind and non-blind situations, but also that it is robust against translational, orientation deviations etc.

Various measures can be used for computing the Gaussianity/non-Gaussianity of the image, with kurtosis and negentropy being the main ones used. Spatial domain nonGaussianity measures were used for blind image deblurring and denoising by Inland Husain in [86]. The measure and scheme based on it are defined in Section 3.9.Non-Gaussianity measure in the frequency domain, termed spectral non-Gaussianitymeasure, has been investigated in this research work as an alternate, more robust and computationally efficient IQM as compared to spatial kurtosis. The new frequency domain non-

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Gaussianity IQM, spectral kurtosis, is presented in the research work illustrated in chapter 4.

Blind/Reference-less Image Spatial Quality Evaluator (BRISQUE)

BRISQUE is a spatial domain natural scene statistic based distortion-generic nonreference IQM scheme. It utilitzes the scene statistics of coefficients of locally normalize-luminance to keep the "naturalness". This model uses regression between features and quality. For a distorted image g, mean subtracted contrast normalized coefficient at each pixel is gained by,

$$\hat{g}(m,n) = \frac{g(m,n) - \mu_g(m,n)}{\sigma_g(m,n) + C}$$

(3.25)

with,

$$\mu_g(m,n) = \sum_{k=-U}^{U} \sum_{l=-V}^{V} w_{k,l} g_{k,l}(m,n)$$

(3.26)

$$\sigma_g(m,n) = \sqrt{\sum_{k=-U}^{U} \sum_{l=-V}^{V} w_{k,l} (g_{k,l}(m,n) - \mu_g(m,n))^2}$$

(3.27)

and C is a constant. w={wk,l|k=-U,….U,l=-V,….V} weighing function with U=V=3. Lower BRISQUE values are desired for higher quality of results.

Natural Image Quality Evaluator (NIQE)

It is a completely non-reference quality analyzer that only makes use of measurable deviations from statistical regularities observed in natural images, without ground-truth, to provide quantitative comparisons. The model used for BRISQUE is also used for NIQE except there are some features of natural scene statistics used. The lower the NIQE, higher the image quality would be.

Independent Component Analysis (ICA)

In view of Blind Signal Separation ICA is a method to uncover the unshown factors that basic arrangements of arbitrary factors, estimations, or sign. ICA characterizes a generative model for the watched multivariate information, which is regularly given as a huge database of tests.

Maximum Non-Gaussianity Principle

Principle can be quoted as follows "Find the local maxima of non-Gaussianity of a linear combination y=∑bixi under the constraint that the variance of y is constant. Each local maximum gives one independent component." [36]Higher order cumulates have been used for BSS problem before [109]. Kurtosis, a fourth order cumulate, and negative entropy are two measures used in ICA to calculate the non-Gaussianity of a signal [73]

Limitations of ICA

Although ICA-based schemes provide a framework to apply statistical independency concepts to blind deconvolution problems; their performance remains limited because of lack of observation samples, a prerequisite for BSS problems. Applying ICA on BSS or blind deconvolution problem requires fulfilling its pre-conditions, which essentially means providing as many observations as underlying sources and independency among all observations. Further, only one underlying source or observation can have a Gaussian distribution. As the convoluted signal is reverberate of its own adjacent samples or pixels (in case of an image) which are mixed as per the proportion defined by the PSF; thus resulting in single observation only. In order to have multi-channel representation as required by ICA, one has to resort to some alternate representation technique.

IV. PROPOSED SYSTEM

Introduction

A new possible substitute to the non-Gaussianity based deblurring measures is introduced in this chapter as the Blind Image Quality Measures (IQMs). In simulated blurring cases the pristine image and deblurred image can be used to calculate quality measures PSNR, MSSIM, etc. During BID, the source image is unavailable and an error image among the source and deblurred image cannot be calculated. This in turn leads to the impossibility of measuring the improvement in terms of error based or full-reference quality measures. It therefore raises the need to look for quality measures that can judge the deblurred image's quality without the need for a reference pristine image, or in other words, a measure that does not require a reference. In this research work, the existing blind IQMs BRISQUE and NIQE have been investigated as alternate deblurring measures for BID. A novel full-reference yet blind quality measure is also proposed as IQM for blind deblurring.

BRISQUE and NIQE as Deblurring Measures

Both BRISQUE and NIQE does not require a reference image, it makes them good candidates by which to judge the quality of the deblurred image in BID. Using these measures, a deblurred image can be regarded as the best calculated approx. values of the original image at the point

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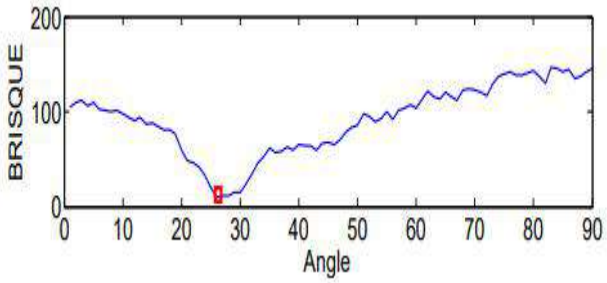
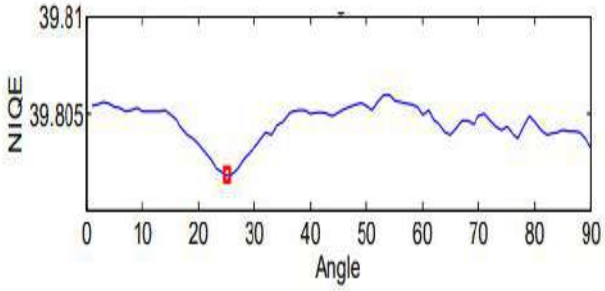
where the measurements are at minima. Figure 4.1(a) shows the deblurred image of the motion blurred (having blur PSF of length 11 pixels and angle 25 degrees) Barbara image. In figure 4.1(b) and (c) show the BRISQUE and NIQE plots are shown at different angles. Both these measures minimize in the near vicinity of the true blurring PSF parameters. The angles estimated by BRISQUE and NIQE are 26 and 25 degrees, respectively.

(a)



(b)



(c)

Fig.4.1 (a) An Image with Motion Blur (b) BRISQUE Plot (c) NIQE Plot

Re-blurring Based Quality Measure for Blind Image Deblurring

An overview of the Re-blurring based BID techniques is shown in Fig. 4.2. The blurry image is given to the Restoring Filter to deblur and get image *f* which is then. re-convolved with PSF *h* to re-introduce blur in the image and obtain re-blurred image *g'*.A noise free restoration filter is desired to reproduce the same blur. To measure the similarity between the originally blur and re-blurred images, in this research, the PSNR measure has been utilized for comparison thus naming the proposed measure Re-blurring based PSNR (RPSNR).

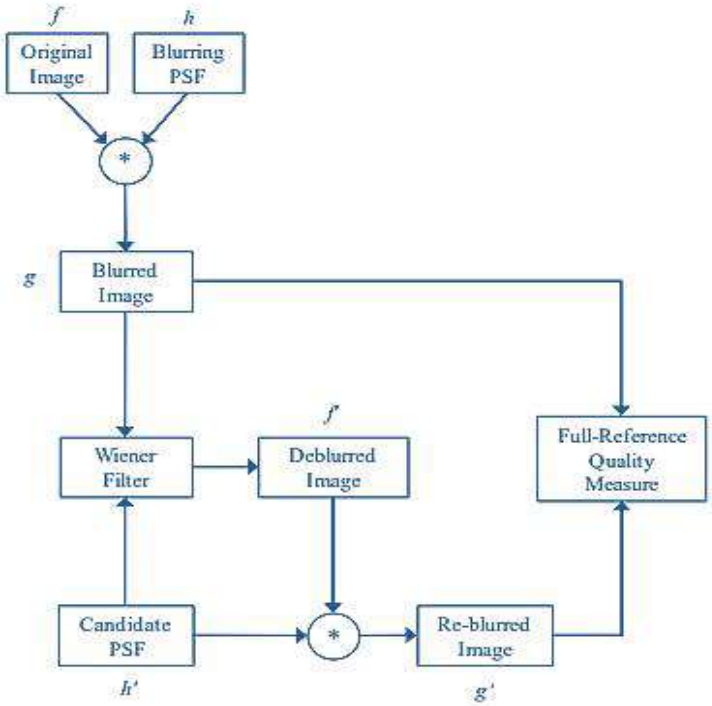


Fig.4.2. Schematic Diagram of the Re-blurring based BID Scheme

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The deblurring result can be arranged into two unique situations. In the principal case, Wiener channel rebuilding is performed for an applicant channel like the first obscuring PSF. In the other situation where the Wiener channel is furnished with a competitor PSF not quite the same as the first obscuring PSF.

For instance, of the working of the plan, in Fig. 4.3 a unique picture obscured with movement obscure PSF at a point of 37 degrees, at that point deblurred picture is like the first picture with immaterial level commotion and ringing. The pictures acquired subsequent to deblurring were contaminated by clamor and ringing issues.

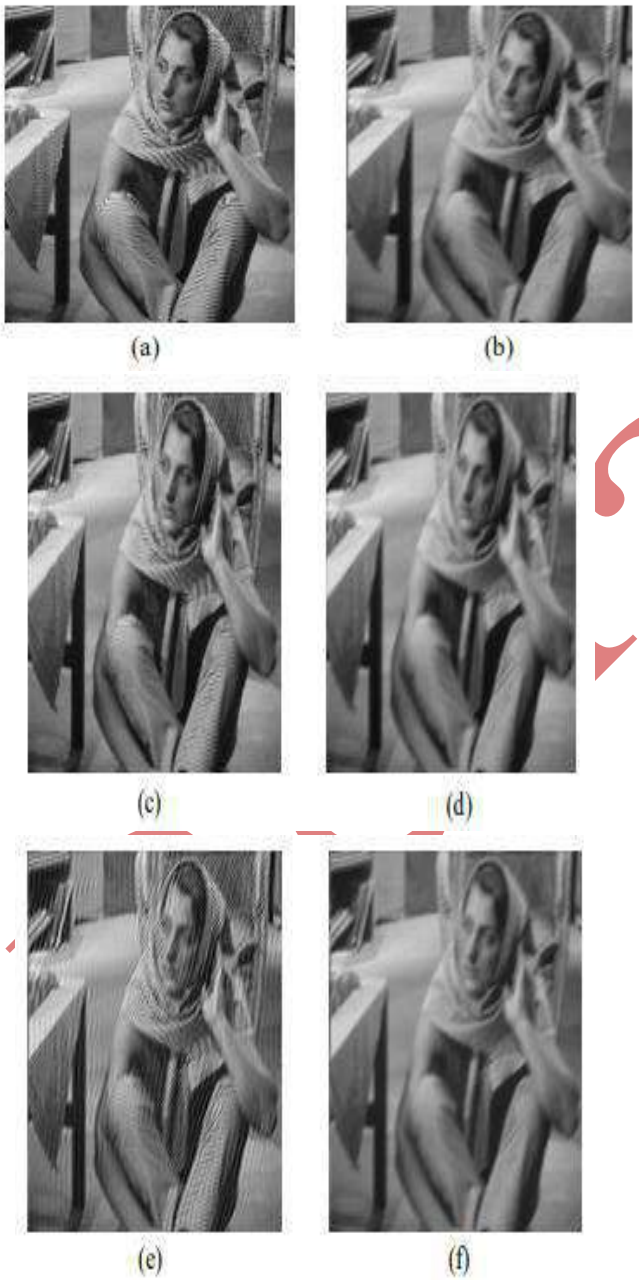

Fig. 4.3 (a) Original Image (b) Blurred Image (c)(e)(g) Images Deblurred with PSF angle 37, 16 and 52, with their respective Re-blurred Images in (d),(f) and (h)

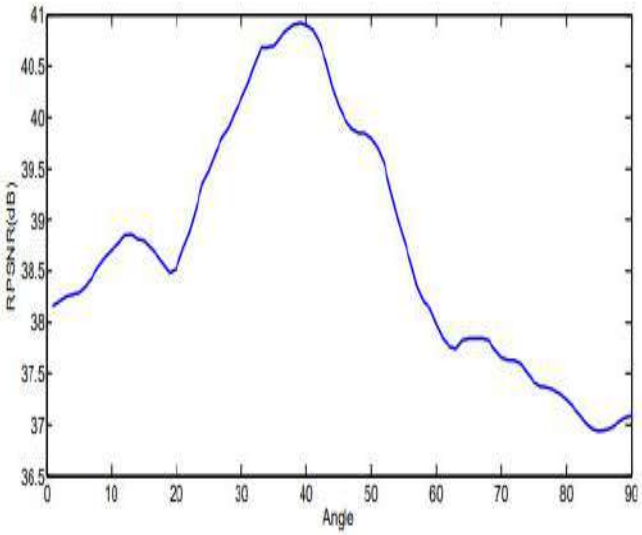

Fig. 4.4 RPSNR plot for Deblurring of Motion Blurred Barbara Image having PSF at angle 37 deg. The RPSNR Measure estimates the true blurring angle as 38 degrees at its maxima.

Fig. 4.4 shows the RPSNR plot for the deblurring of the blurred Barbara image in Fig. 4.3(b). The RPSNR measure during deblurring estimates the true blurring angle as 38 degrees at its maxima.

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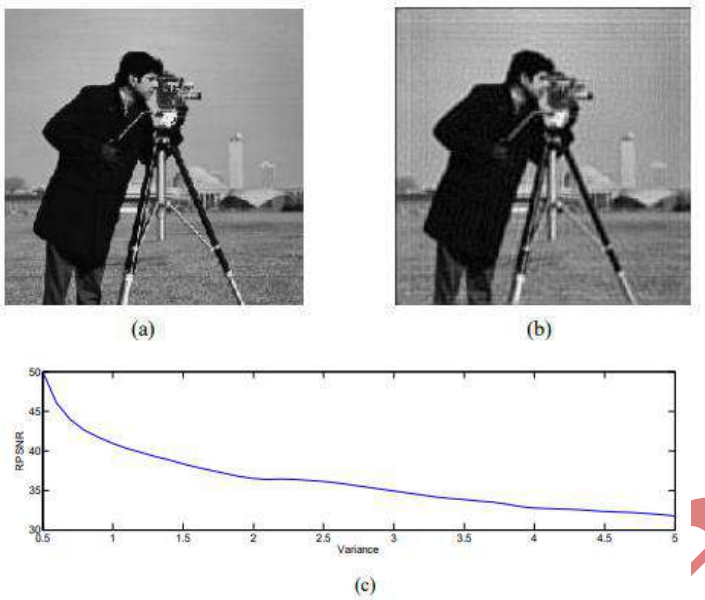

Fig.4.5 .RPSNR plot for deblurring of Gaussian Blurred Image with true blur variance of 2. The RPSNR measure incorrectly identifies the true blur variance as 0.5

The Re-blurring based BID scheme is limited to the deblurring of motion blurred images. The deblurring results for artificially blurred Gaussian and OF Images show that the RPSNR measure fails to depict a global maximum value near the true blur parameters. Fig. 4.5 and Fig. 4.6 show the deblurring results in case of Gaussian and OOF blurred images.

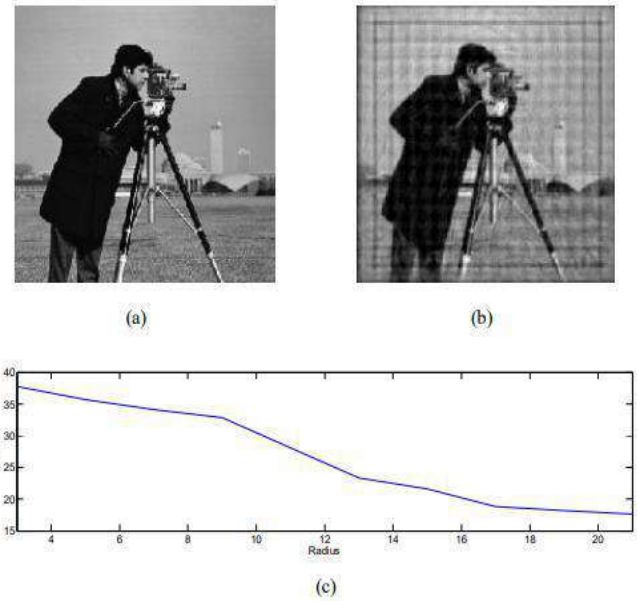

Fig. 4.6 RPSNR plot for deblurring of OOF blurred image with true blur radius of 11. The RPSNR measure incorrectly identifies the true blur radius as 1

Deblurring Results for Artificially Blurred Images

Simulations were carried out to test the efficiency of the blind IQMs BRISQUE and NIQE and the full-reference blind IQM RPSNR. BRISQUE, NIQE and RPSNR have been tested as alternative deblurring measures. Experiments include testing of artificially blurred images as well as realistically blurred images. In the artificial blurring cases, the three types of Parametric Blurs; i.e. Motion, OOF and Gaussian, have been considered. Fig. 4.7 shows the Cameraman image with blur at an angle of 35.35 degrees. The corresponding RPSNR, spatial and spectral kurtosis plots for deblurring are also shown. The RPSNR error measure estimated the angle as 32.5 degrees while spatial and spectral kurtosis estimated 32.25 as the

https://dx.doi.org/10.22161/ijaers.69.4 ISSN: 2349-6495(P) | 2456-1908(O)

blur angle. Angle step size in this case was 0.25 degrees. This shows that the RPSNR measure maximizes in the near vicinity of the true blurring parameter value.

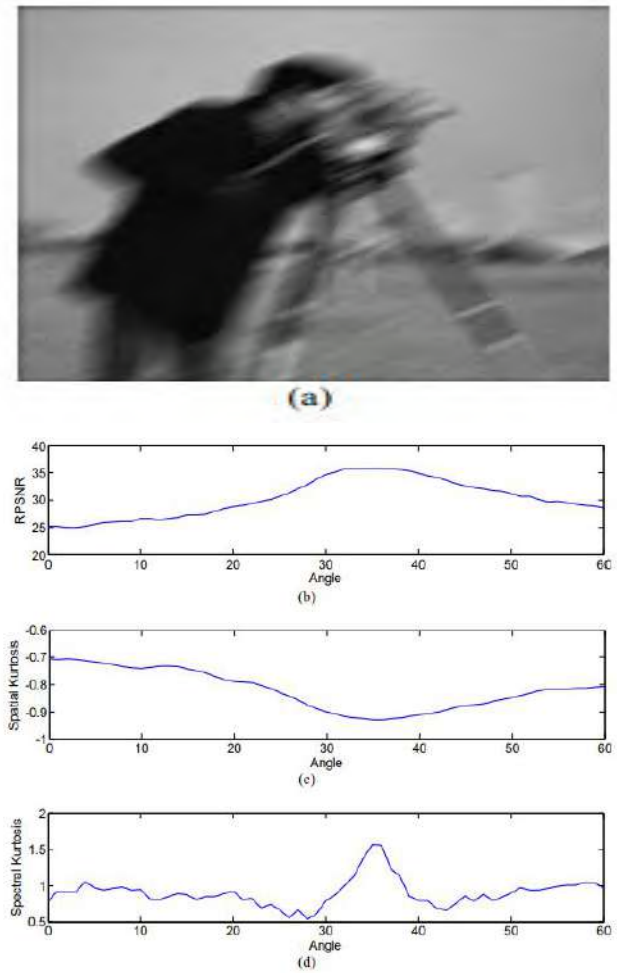

Fig.4.7 (a) Blurred Image (b) RPSNR Plot (c) Spatial Kurtosis, (d) Spectral Kurtosis Plot

Table 4.1 summarizes the RPSNR results for the artificially blurred Waterloo Bragzone images. In this case, motion blurred images were used and the blur angle, theta, was estimated. The estimated values are in close vicinity of the theta values used to blur the images. PSNR in decibels (dBs) has been calculated for three set of images: blurred and re-blurred, original and blurred and original and deblurred. A higher value of PSNR shows image of high quality.

Table 4.1 PSNR comparison for the RPSNR based BID scheme

Figure	Original Theta	Calculated Theta	Blurred Reblurred PSNR (dB)	Original Blurred PSNR (dB)	Original Deblurred PSNR (dB)	Wiener-Filter NSR
Barbara	32.55	32	47.03	18.72	22.42	3.01e-03
Cameraman	47.45	46	40.84	15.29	24.41	4.01e-03
Goldhill	11.19	11.5	51.99	19.2	25.84	4.01e-04
Lena	111.21	110.5	44.82	19.74	26.09	3.01e-04
Mandrill	175.67	176.75	32.75	17.14	19.24	3.01e-04
Peppers	85.36	85.5	32.97	18.43	18.92	3.01e-04

https://dx.doi.org/10.22161/ijaers.69.4 *ISSN: 2349-6495(P) | 2456-1908(O)*

Deblurring Results for Realistically blurred Images

Deblurring results of the blind IQMs for realistic images are given. In these, images under the effect of different types of blur including atmospheric blur, motion blur and OOF blur are included. The results are compared to the spatial and spectral kurtosis-based estimates to gauge the efficacy of the deblurring measures. The estimated PSF are given in Table 4.2.

Table 4.2 Deblurring Results for Realistic Motion Blurred Images

Image	Estimated Values								
	Spatial Kurtosis			Spectral Kurtosis			BRISQUE		
	Length	Angle	SNR	Length	Angle	SNR	Length	Angle	SNR
Fig. 4.7 (a)	71	-2	4.01E-03	77	3	4.01E-02	71	0	4.01E-03
Fig. 4.8 (a)	19	80	4.01E-02	19	90	4.01E-02	15	81	4.01E-02
Fig. 4.9 (a)	16	161	4.01E-03	21	160	4.01E-03	20	161	4.01E-03

Image	Estimated Values					
	NIQE			RPSNR		
	Length	Angle	SNR	Length	Angle	SNR
Fig. 4.7 (a)	73	3	4.01E-03	77	3	4.01E-03
Fig. 4.8 (a)	17	87	4.01E-03	19	80	4.01E-02
Fig. 4.9 (a)	17	156	4.01E-03	21	156	4.01E-03

In Figure 4.8 (a), an image with motion blur shows unreadable text. An ordinary digital camera clicked this image with person in motion while being clicked. The image in Fig. 4.8(b), (d) and (e) seem to have recovered well by deblurred with PSF estimated using the spatial kurtosis, RPSNR and BRISQUE based BID schemes, respectively. In the case of spectral kurtosis and NIQE based BID scheme, the images in Fig. 4.8(c) and Fig. 4.8(f) do not recover well.

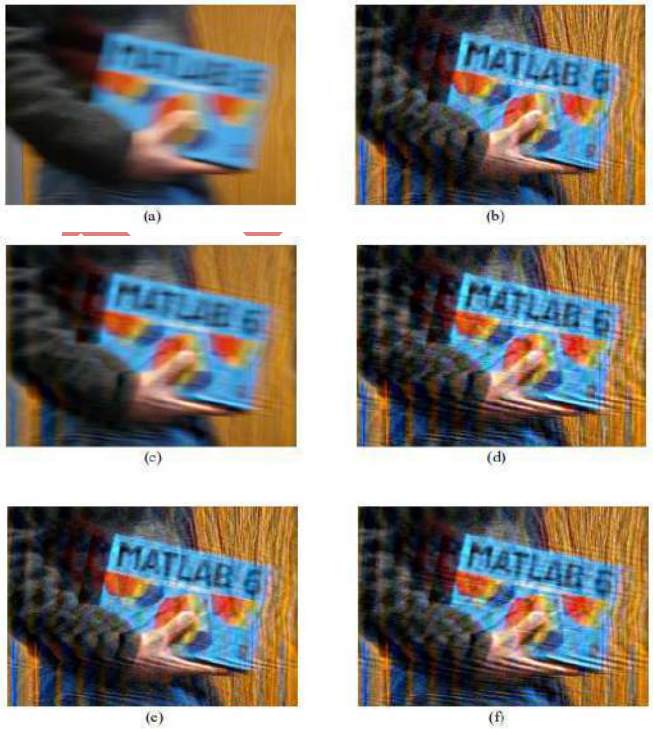

Fig.4.8 (a) Blurred Image (b) Spatial Kurtosis Measure (c) Spectral Kurtosis Measure. (d) RPSNR Measure (e) BRISQUE Measure (f) NIQE Measure based BID scheme

Proposed BID Scheme for Arbitrarily Shaped PSF Estimation

A PSF can be assumed as an array of random values under the constraints mentioned below:

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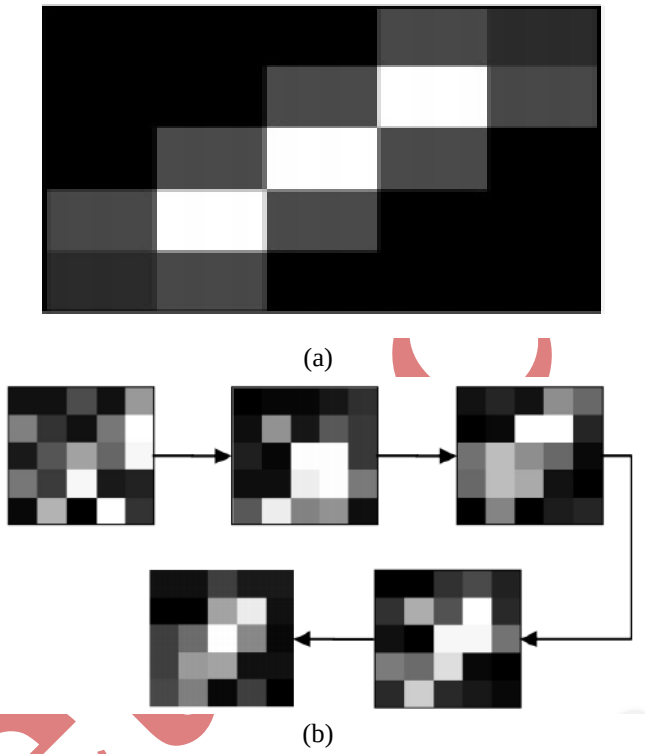
- The PSF has certain row (m) and columns (n) with the finite support size.
- The energy of the PSF is maintained i.e. $\sum h(m, n) = 1$
- The PSF is space invariant. The same blurring/averaging effect is presented by the blurring kernel at each pixel location.
- The PSF coefficients are non-negative.

During each iteration, a coefficient value is updated in the direction of improved deblurred image quality which can be calculated using any restoration measure e.g. spatial or spectral non-Gaussianity measures, non-reference or full-reference IQMs etc. The process can be evaluated for a fixed number of iterations or it can be terminated when the difference in the measure value in subsequent iterations is lower than a specified threshold value.

Fig. 4.9 shows a glimpse of the restoration process by estimating the PSF coefficients. The original PSF is depicted in Fig. 4.9 (a) while the estimation process is illustrated in Fig. 4.9 (b). From an initial set of random values, the process keeps on estimating/changing the PSF weights till the deblurring measure stops showing improvement.



(a)

(b)

Fig.4.9 (a) Blurring PSF (b) PSF Estimation Process through different steps

The deblurring scheme is optimized using GA. An added advantage of such a BID scheme is that the same method can easily be extended for estimating other types of blur apart from camera handshake. Also, the BID scheme based on GA is flexible and so it can be easily incorporated with any deblurring measure as the fitness function. Details of the GA based optimization are as follows:

- Step 1: Initiate the GA process with population, crossover rate, size, mutation rate etc.
- Step 2: Generate an initial chromosome population where each chromosome contains information about all the coefficients of the finite support size PSF.
- Step 3: Iterate, find the restored image through Wiener filtering for all the chromosomes.
- Step 4: Calculate fitness function values for the initial population.
- Step 5: Select the best fitting group of chromosomes based on either roulette or Threshold based selection.
- Step 6: Generate a new population from the chromosomes selected in Step 5 through crossover and mutation. Each crossover is performed with probability pc {0.5-0.8} and cross over points are selected at random. Mutation involves modification of components of the individual chromosomes with probability pm {0.001-0.01}. Roulette wheel selection is used to select the best fitting individuals among the populations.

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- Step 7: Keep the process repeat from 3rdStep till it converges for the deblurring measure.

Deblurring Results for Artificially Blurred Images

Since the BID scheme can also be extended for uniform parametric blurs, the algorithm was first evaluated for the less complex parametric form blurs before testing it for arbitrarily shaped PSFs. Results of deblurring the Gaussian, motion and OOFPSF based blur are presented below.

Restoration of Parametric PSF Blurred Images

The first set of tests included deblurring images blurred by Gaussian PSF. Results of deblurring for Gaussian PSF blurred images is shown in Fig. 4.10. It can be observed that the estimated PSF takes on a rough shape of the blurring PSF as viewed in Fig. 4.10(e). Results presented here were obtained when the algorithm stopped, as the tolerance value for the fitness function was attained. The restored image appears sharper and much more detailed than its blurred counterpart.

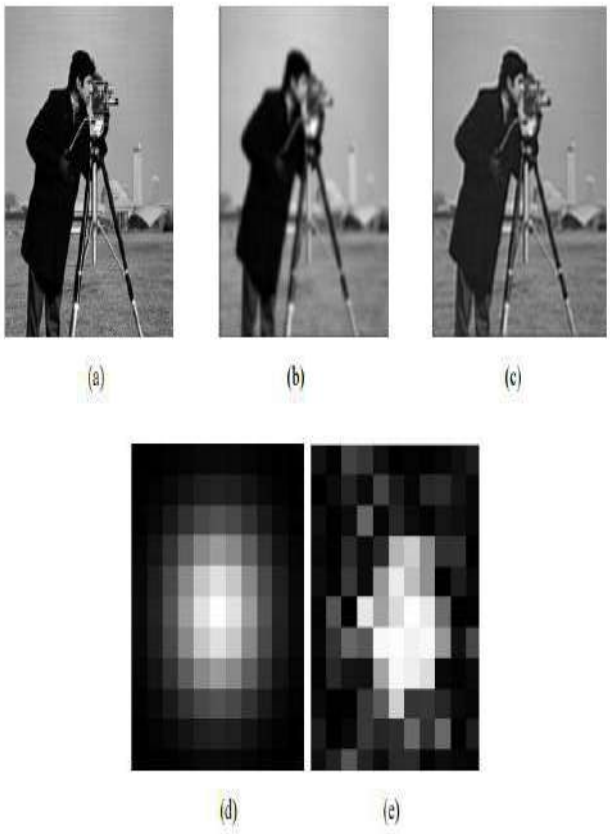

Fig.4.10 Deblurring Result for Image Blurred by Gaussian PSF of Size 11 x 11 Pixels and Variance σ 2 =2. (a) Original Image (b) Blurred Image (c) Deblurred Image (d) Blurring PSF and (e) Estimated PSF

The second set of tests included deblurring images artificially blurred by motion blur. Fig. 4.11 shows such case. And Fig. 4.12 shows the results of deblurring for Barbara images under the influence of OOF blur with the radius of 9 pixels. Deblurring results show the estimated PSF converging towards the original blur PSF. For large OOF blur, a lot of attenuation occurs for the high frequency elements in the image and recovery in this case is not that sharp as observed for the Barbara image in below figure (c)

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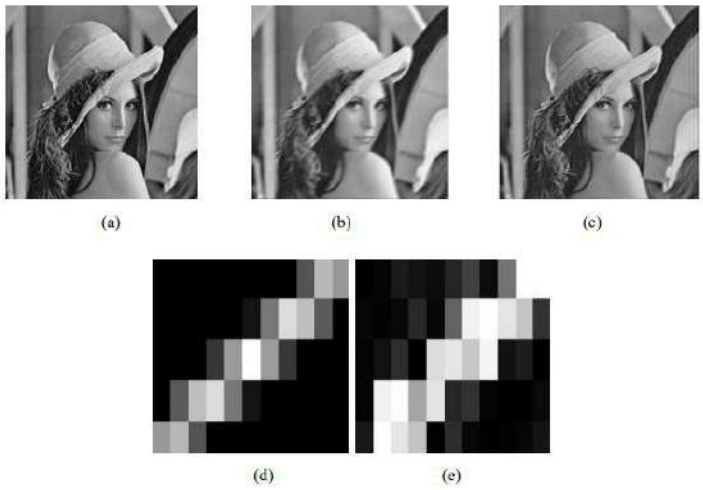

Fig.4.11 Deblurring result for image blurred by the Motion Blur PSF with length of 11 pixels and the angle as 23°. (a) Original, (b) Blurred, (c) Deblurred, (d) Blurring PSF and (e) Estimated PSF

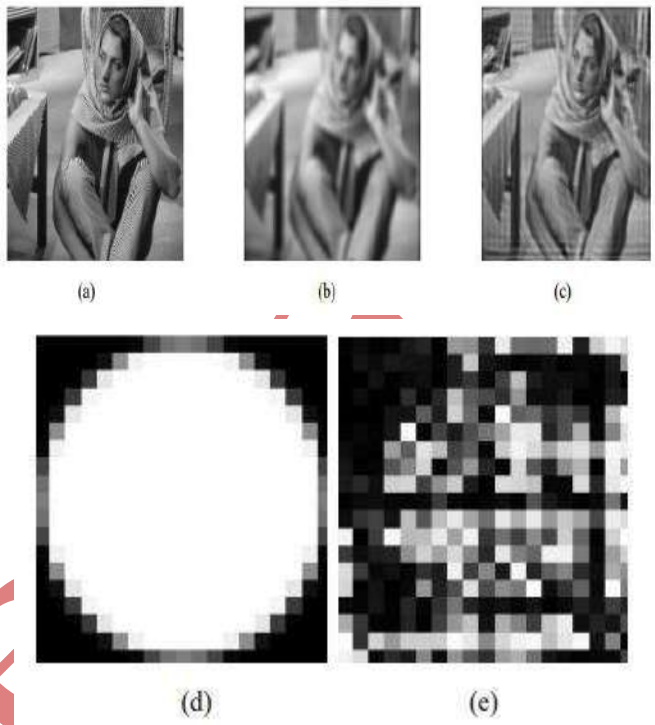

Fig.4.12 Deblurring Result for Image Blurred by OF Blur PSF with Radius of 9 Pixels. (a) Original (b) Blurred (c) Deblurred (d) Blurring PSF and (e) Estimated PSF

Deblurring Images Blurred by Arbitrarily Shaped PSFs

Arbitrarily shaped PSFs were used to blur the images and then recover using the proposed scheme. Deblurring results shown in figures depict that the proposed algorithm was able to estimate the blurring shape/coefficients to a great extent. The deblurred images appear sharper than their blurred counterparts.

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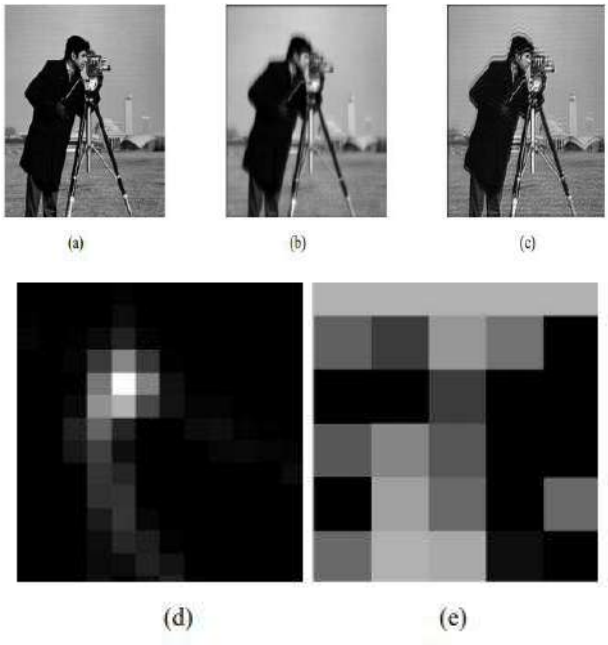

Fig. 4.13 Deblurring result for Cameraman Image blurred by arbitrary PSF of size 15 x 11 pixels. (a) Original, (b) Blurred, (c) Deblurred, (d) Blurring PSF and (e) Estimated PSF

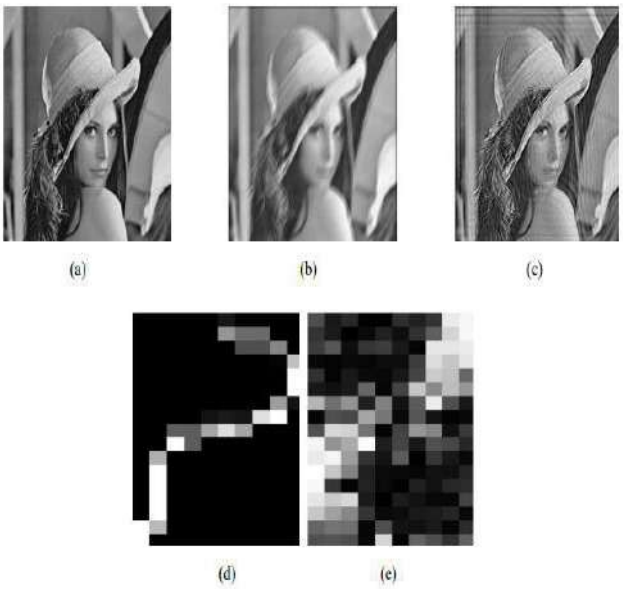

Fig.4.14 Deblurring result for Lena image blurred by arbitrary PSF of size 16 x 10 pixels. (a) Original, (b) Blurred (c) Deblurred, (d) Blurring PSF and (e) Estimated PSF.

Table 4.3 illustrates the IQMs values for the images deblurred using the arbitrarily shaped PSF estimation scheme.

Table 4.3 Deblurring results for artificially blurred images. Deblurred image quality is evaluated using BRISQUE and NIQE IQMs

Figure Name	Blurring Filter	Size (Pixels)	Parameter Value	Image Quality Measured using BRISQUE			Image Quality Measured using NIQE		
				Original	Blurred	Deblurred	Original	Blurred	Deblurred
Fig 4.10	Gauss.	11x11	Var = 2.0	6.68	35.88	47.27	5.11	4.57	6.89
Fig	Motion	5x11	L=11, A=23	10.26	16.67	52.07	5.11	4.69	7.19

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4.11									
Fig 4.12	Out of Focus	19x19	R=9	50.12	30.57	63.38	4.98	6.12	9.66
Fig 4.13	Arb.	15x11	-	14.13	17.95	36.43	5.50	5.94	7.56
Fig 4.14	Arb.	16x10	-	15.45	20.77	49.80	4.98	5.72	6.30

V. IMPLEMENTED MODEL

Introduction

A GUI enables the user to easily access and use software. It can save valuable time and avoid trouble by evaluating user desired function through a platform of function button and other easy access tools. The lack of GUI results in creating unnecessary difficulty for the user to operate the BID scheme. Most of the BID schemes visited in the literature that result from scientific research usually lack a GUI and are thus not available in the form of toolboxes or individual software. Some of the major reasons are as follows:

- BID algorithms may not be completely automated because of their dependency on such human intervention at different stage(s) of deblurring that cannot be covered by the GUI tools. In such cases multiple files of codes are rather utilized to perform the BID in multiple stages manually by obtaining result from one code file and putting it in another code file as in the case of Shan et al. [39] BID scheme.
- Most of the BID schemes usually address a limited range of the deblurring 128 problems i.e. either dealing with parametric or non-parametric blur, space invariant or variant blur etc. GUI development in such case would only be useful for limited users.
- BID schemes may not be computationally efficient or they may require further modifications to enhance their deblurring results and thus incorporating them in form of GUI at early stages is not desired.

The benchmark BID schemes (Shan et al. [39], Fergus et al. [17] and Whyte et al. [18]) used for comparison in this research work also lack a graphical interface. Shan et al.'s BID scheme requires command line input to Windows batch files and lacks GUI. The user has to input different parameter values to the batch file required to conduct BID on the image. Fergus et al. and Whyte et al. BID schemes use MATLAB code and require user interaction in image loading, parameter setting in code files to deblurring result presentation. Recently presented BID schemes

In this research, a GUI Model for non-blind image deblurring was developed during the early stages and was regularly updated to incorporate many additional features including region based deblurring, blind IQMs for BID and parametric and nonparametric PSF estimation. After the successful use of blind IQMs for BID, the toolbox was updated to incorporate a GA based BID scheme which can use any of the blind IQMs as a fitness function. It can estimate parametric and arbitrarily shaped PSFs as well.

Key Features of Implemented Model

The toolbox and the related GUI have features incorporated which allow for:

- Deblurring the complete image or section of it. A moveable bounding box is provided for the user to select any or whole region of the image to deblur as shown in Fig. 5.1 and Fig. 5.2.
- Deblurring with different restoration filters: Wiener, Richardson-Lucy and Regularized. The user can select among any of these classical restoration filters and update their parameter settings.
- Sliders for setting values for PSF parameter(s) in the case of non-blind deconvolution.
- Deblurring different types of blurs, Gaussian, motion and autofocus blur.
- Setting values for PSF parameters, e.g. PSF size and variance for Gaussian blur, and radius for autofocus blur, length and angle for motion blur for non-blind deconvolution. The parameter values can be set manually.
- Ringing reduction by using edge-taping technique applied to the image prior to deblurring. This feature is embedded in the code and is always applied to the image.
- File loading and saving and layout change. Image file can be loaded for BID and the deblurred result can be saved using a Windows based file explorer.
- The GUI can execute the code in either serial or parallel mode as desired by the user.

https://dx.doi.org/10.22161/ijaers.69.4 ISSN: 2349-6495(P) | 2456-1908(O)

- The GUI allows for easy modification and amendment of the features.

The model is built using MATLAB and its GUI implementation framework named GUIDE as it allows for an easy creation and updating of the GUI. GUIDE based GUI is coded by separate function allowing for easy access and incorporation of future updates. The MATLAB based GUI also supports parallel processing by simply using its distributed computing techniques. The following sections discuss briefly the design and implementation of the toolbox.

Model Design

The flowchart for the toolbox is presented in Fig. 5.1 shows the workflow of the Model. The Model's functionality can be divided into three main parts: the data input, BID algorithm execution and the deblurring output section.

Data Input

The toolbox takes the image file in three common image formats at the moment i.e. JPEG, TIFF and PNG. Other formats are also available as optional to the user. After the GUI loads, the user can load an image file by browsing through the computer directory and locating the image file as shown in Fig. 5.2. Once the image is loaded, the user can relocate the bounding box that selects the image section as shown in Fig. 5.3. By default, it covers the whole image.

The user then needs to specify the initial PSF size used for estimation. The user can also select among different deblurring filters i.e. Wiener, Richardson-Lucy and Regularized filter as shown in Fig. 5.4. Settings of the filter need also be input e.g. NSR for Wiener filter, number of iterations for Richardson-Lucy filter etc.

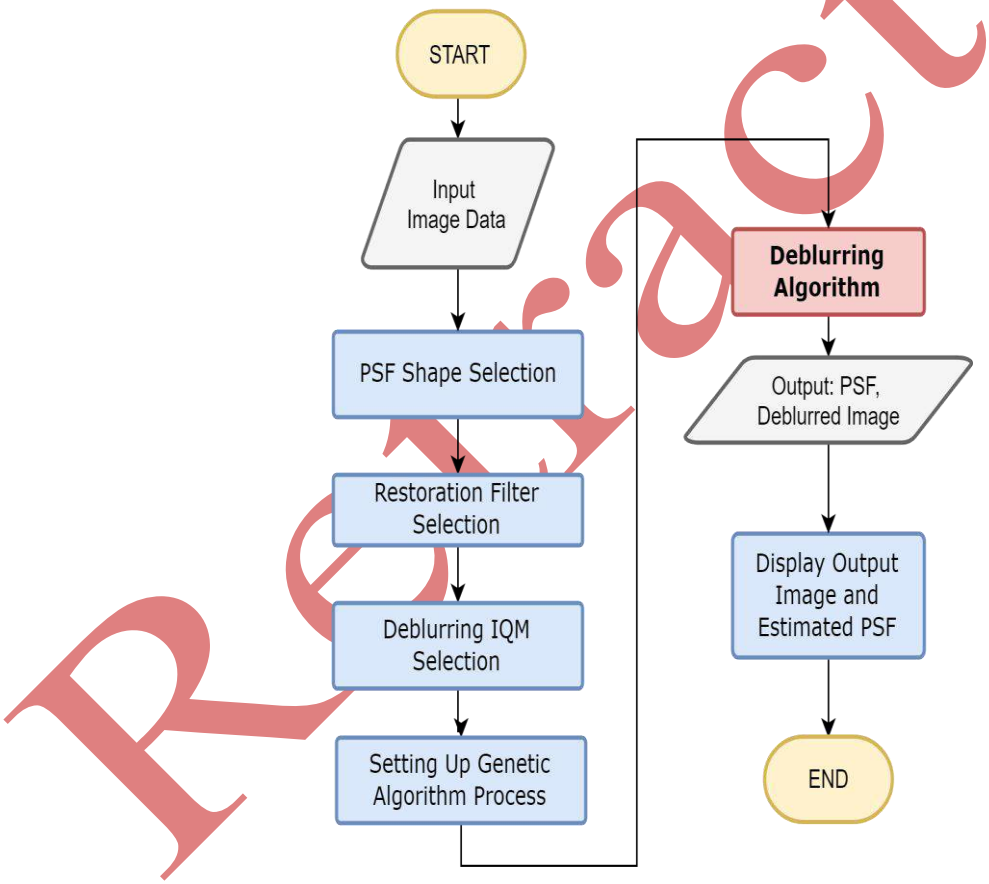

Fig.5.1 Flowchart presenting the BID Model Implementation

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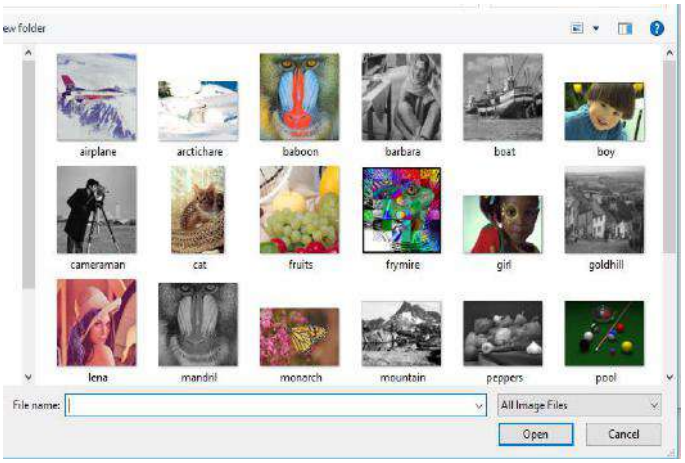

Fig5.2. The image loading window available in the BID Model for Selecting an Image

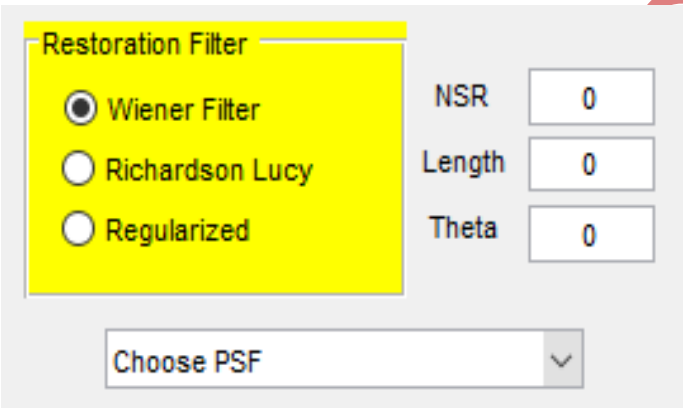

Fig.5.3 Different Filters available for BID in the GUI Model

The user has the choice of selecting among different IQMs as fitness function for the GA. List of the IQMs is given in Fig. 5.5.

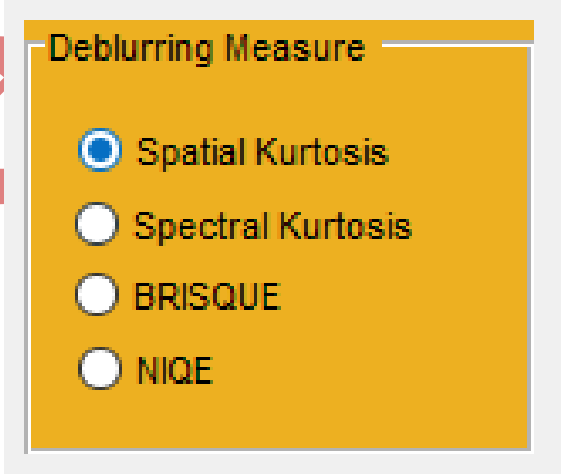

Fig.5.4 Different Deblurring Measures for BID in the GUI Model

The GA settings need to input by the user as well, if not the default values for number of iterations, initial population size, fitness function tolerance etc. are used. Advanced settings of the algorithm include parameter tuning for mutation rate, crossover rate, parallel processing etc. The setup screen is shown in Fig. 5.5.

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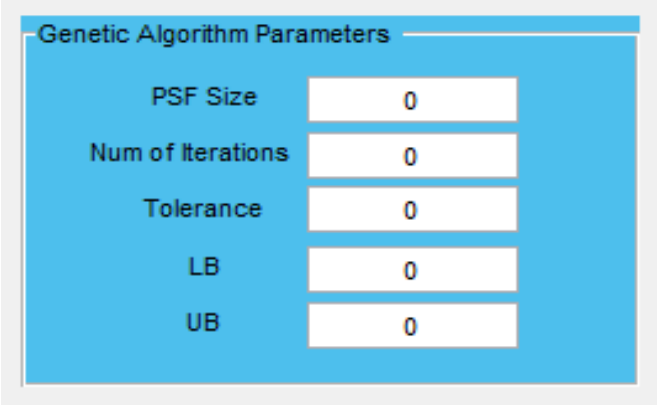

Fig. 5.5 GA Setup Screen for BID in the GUI Model

Deblurring Output

Fig. 5.6 shows an overview of the GUI Model where the complete image is deblurred. The picture has been deblurred using a motion blur PSF and angle 0 degrees using a Wiener filter.

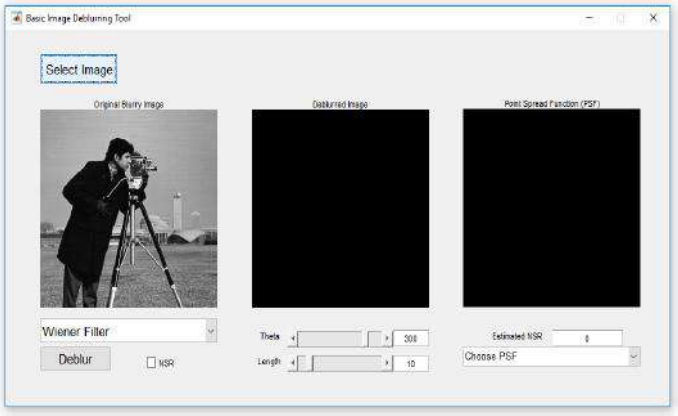

Fig. 5.6 BID Model for Non-Blind Image Deblurring.

Fig. 5.7 shows the latest GUI for the BID Model which allows for the estimation of arbitrarily shaped PSFs. It also has features to load the blurred image and save the deblurred image. Other different options are also available in the main menu. The toolbox allows the user to select from different restoration filters and provides easy access to their settings. The deblurring algorithm is optimized through GA. The GA parameters can be set up simply. The deblurring algorithm can be optimized on a multiple core machine as well. The user can select from four deblurring measures as the fitness function for the GA. These deblurring measures are spatial and spectral kurtosis, RPSNR, BRISQUE and NIQE. By using the proposed Blind Image Deblurring Model in Section 5.2, GA aims to estimate the PSF coefficient values for a coefficient matrix whose size has to be input by the user. This toolbox therefore provides a single base to tackle the BID problem for images blurred by parametric and arbitrarily shaped PSFs using any of the deblurred measures.

https://dx.doi.org/10.22161/ijaers.69.4 ISSN: 2349-6495(P) | 2456-1908(O)

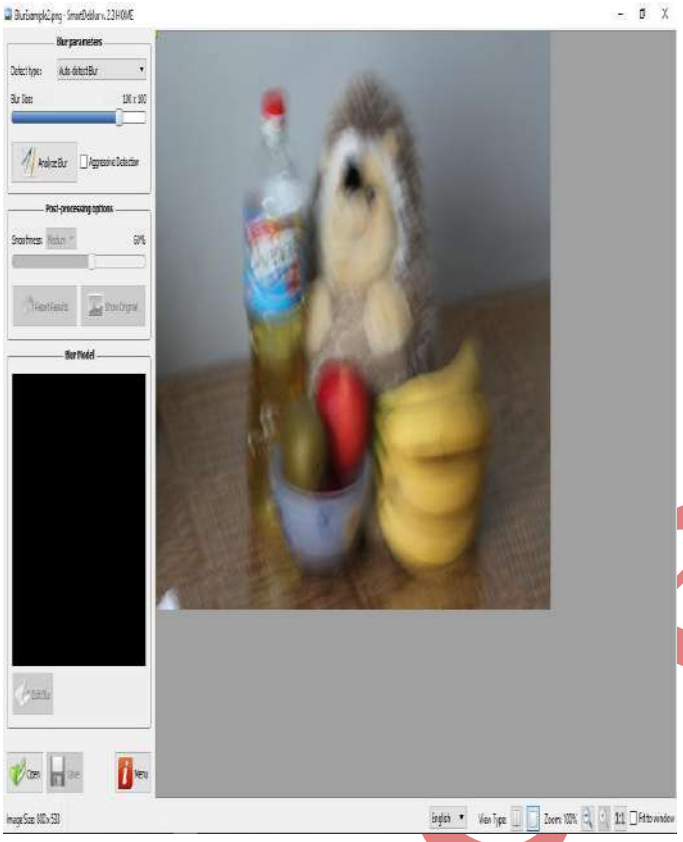

Fig. 5.7 GUI Model for blind PSF estimation and Image Deblurring

Comparison with Other BID Models

Other BID toolboxes are available and are their functionality is discussed in comparison to the proposed BID scheme's GUI. This includes the Smart Deblur Toolbox. The toolbox allows for manual deblurring of out-of-focus and motion blurred images. The user has to manually adjust the blur parameters and search for the best parameter values to deblur the image. It allows the user to adjust motion blur length and angle parameter and radius parameter of out-of-focus blur. The smoothness parameter allows the user the level of deblurring residual blur and the correction strength allows the level of deblurring to be applied on th**e blur image.**

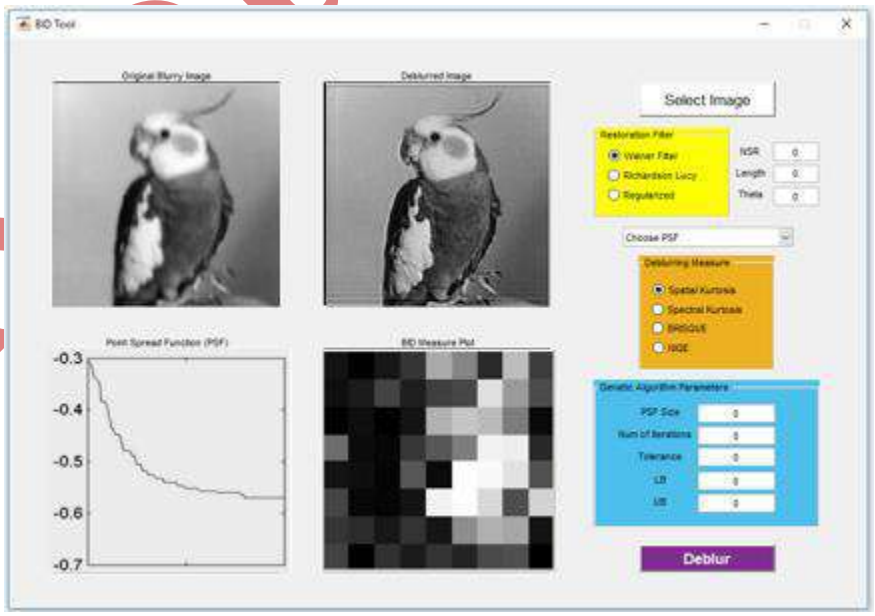

Fig. 5.8 Smart Deblur BID Toolbox for Manual Deblurring

https://dx.doi.org/10.22161/ijaers.69.4 ISSN: 2349-6495(P) | 2456-1908(O)

VI. CONCLUSION

This research was an investigation to establish that the blind image deconvolution problem can be solved to a fair degree of complexity by using the information theoretic concept, where, an independent signal has certain useful information. The focus was carried out on issues of BID (i.e. design and implementation of a robust BID Measure, estimation of PSFs and definitely deblurring of blurred images with enhanced efficiency and quality), and finding a solution.

Blind IQMs were investigated as feedback deblurring measures to the BID. These include; spatial kurtosis, spectral kurtosis, RPSNR, BRISQUE and NIQE index. Spatial kurtosis has been previously used for BID while existing measures, BRISQUE, NIQE and spectral kurtosis taken as deblurring measures for BID. A novel full reference yet blind IQM, RPSNR designed and used in this research work.

Starting with the spatial kurtosis-based BID scheme as a reference, the spectral kurtosis-based BID model was designed and implemented. Some of the features of this scheme are as follows:

- Since the spectral kurtosis measure is calculated in the frequency domain thus limiting the need for Inverse Fourier Transform which is required for the calculation of spatial domain IQMs (spatial kurtosis, RPSNR, BRISQUE and NIQE). This makes spectral kurtosis computationally efficient. However, MATLAB's Wiener filter implementation also has other severe overheads losing the per iteration efficiency.
- Spectral kurtosis maximizes for increased blurring unlike spatial kurtosis which increases and decreases for sub-Gaussian and super-Gaussian image. This makes the BID scheme based on spectral kurtosis easily automatable.
- Experiments were carried out on a number of test images with various blurring parameters. Spectral kurtosis-based BID scheme is robust as it is able to estimate the blurring parameters over a wide range of images and its performance is not marred by ringing artifacts and inherent deblurring noise in the images.
- The proposed method 's deblurring ability is not limited to a single blurring function. The algorithms and gradients are derived for a number of blurs, and the performance improvements are corroborated through a set of simulations. The benefit of using such a model of estimation is that it makes the same BID algorithm easily tunable, allowing it to estimate any of the mentioned parametric blur types using the same IQM.
- A Gradient Descent based scheme was utilized where the parameter(s) of the blur model were worked to optimize and maximizing the spectral non-Gaussianity. The BID scheme was later replaced by the use of a GA based optimization. The GA based BID scheme was used for testing of RPSNR, BRISQUE and NIQE measure as well.

A novel full-reference yet blind quality measure for BID, RPSNR, was designed as an alternative to the spectral kurtosis measure.

- Reference based error computing was not previously possible in BID cases, due to the unavailability of a reference image required for comparison purposes. The RPSNR measure suggests a solution to this problem by calculating error between blurred and reblurred image.
- Deblurring results for artificial and natural (real) motion blurred images based on the RPSNR based BID techniques are encouraging. However, the measure's performance was limited for Gaussian and out-of-focus images.

Non-reference IQMs BRISQUE and NIQE were investigated as deblurring measures alternate to the spatial and spectral non-Gaussianity measures.

- BRISQUE measure based PSF estimates depict better results for deblurring of artificially and real-life blurred images as compared to other IQMs.
- From detailed testing of these measures with deblurring experimentation on the artificial and real-life blurred images, BRISQUE proved to be a very robust but computationally costly PSF estimator. BRISQUE is computationally costly due to its usage of a support vector machine for calculating the image quality.
- BRISQUE based BID estimates PSF for relatively lower NSR values as compared to other IQMs resulting in a comparatively sharper image with presence of deblurring noise.

All the deblurring measures show absolute maxima at the true PSF parameter values except the spatial kurtosis measure, which maximizes for super-Gaussian images and minimizes for sub-Gaussian images. This makes them a better choice in terms of an automatable measure.

In the earlier research work, parametric forms of blurs were used to model the blurring in the images. The IQMs were used to successfully tackle parametric blurs for both artificial and natural (real) blurred images. The parametric model is a mere approximation of the blurring that occurs in real life blurred images. The research study was further extended to focus on the estimation of the arbitrarily shaped

https://dx.doi.org/10.22161/ijaers.69.4 ISSN: 2349-6495(P) | 2456-1908(O)

PSFs that present much more complex forms than their parametric counterparts.

- A GA based novel BID scheme using BRISQUE measure as the fitness function was used to calculate the factors or coefficients of the arbitrarily shaped PSFs.
- The BID scheme's setup allows for the estimation of any type of PSF i.e. atmospheric turbulence blur (through Gaussian approximation), motion blurs, and out-of-focus blur in parametric form with arbitrarily shaped as well. The BID scheme was also utilized for parametric blur estimation as well.
- The proposed BID scheme's estimated PSF coefficients are not exactly the same as the original PSF but are rather a near approximation to the original PSF for blur. This BID technique estimates the PSF coefficients for limited number of iterations which produces a reasonable approximation of the original PSF coefficients.
- The proposed BID scheme requires a fixed PSF size input from the user. In order to estimate the PSF support size, a simple technique based on visual judgment of ringing artifacts in the deblurred image is proposed
- Experimentation with artificially blurred images, for parametric and arbitrarily shaped PSF, depicts excellent restoration results. However, the deblurring capability was not satisfactory when tested on real life blurred images corrupted by arbitrarily shaped PSFs and in presence of a low degree of noise.
- Other benchmark schemes used for comparison also failed to produce any viable result as they were not able to estimate the right PSF shape/coefficients.
- Full reference and non-reference IQMs taken up to measure the quality of reconstructed image after deblurring an artificially blurred image.
- The MATLAB based GUI also supports parallel processing by simply using its distributed computing techniques.

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https://dx.doi.org/10.22161/ijaers.69.5 *ISSN: 2349-6495(P) | 2456-1908(O)*

Monitoring of Corn Growth Stages by UAV Platform Sensors

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Abstract *— Increasing agricultural productivity with economic and environmental sustainability is one of the main challenges in agriculture. The aerial survey platforms known as unmanned aerial vehicles (UAV), so-called drones, allow monitoring, evaluation, and decision support activities to improve the management of crops and herds in farms of any production scale. Vegetation indices are used to map the vegetation cover, mainly on a large scale, using satellite images. However, sensors coupled to UAV platforms provide other indices that can be used to detect the stress load of vegetation at more precise spatial scales. The Visible Atmospherically Resistant Index - VARI and the Green Leaf Index - GLI showed similar performances in the initial vegetative stages of corn crop. Both indices were sensitive to class discrimination at intervals that indicate from bare soil and low vigor (shades of red, orange, and yellow) to the condition of high vegetation vigor (shades of green). The results of vegetation indices in the visible spectrum range prove the applicability of the method for data collection and information extraction related to development and growth of crops. Overall, the indices VARI and GLI appear as a potential alternative for crop monitoring using low cost RGB sensors onboard UAV platforms.*

Keywords *— **Corn, UAV, Vegetation Index, Remote Sensing.***

I. INTRODUCTION

In recent years, interest in automated techniques and procedures to monitor crop growth and development has grown greatly [1, 2, 3]. It seems that the next agricultural revolution will be driven by intelligent use of data that can affect productivity growth and contribute to environmental sustainability. This will be achieved through the rational use of resources, especially in the field of food production and land use. In the agricultural sector, the great leap in robotics is becoming clearer, providing interesting and effective solutions for increasing productivity by means of crop monitoring [4].

The use of unmanned aerial vehicles (UAVs) or drones in farms is becoming increasingly evident. The equipment has emerged from a military past and is currently assisting farmers in activities such as cargo transportation (fertilizers or pesticides), and both cattle and crop monitoring. In relation to orbital platforms, UAVs stand out in the so-called smart farms, as they effectively generate data for information extraction from a close panoramic view of the fields, i.e., they allow to assess the crop status more accurately [5].

Crop monitoring with UAVs can assist the farmer in planning and decision making by paying attention to planting characteristics and soil and climate conditions. Productivity may vary due to sowing time, climate characteristics, management, soil heterogeneity [6], weed infestation [7, 8], water stress [9], stand failure [10], and diseases [3].

UAV platforms are lightweight, low-cost aircrafts operated from the ground and can carry sensors for imaging. The most common sensors are those that collect data in the visible range (RGB sensors). However, there is a variety of sensors, including those that capture information only in the near infrared and thermal band or the multispectral type that can extract information in different bands of the electromagnetic spectrum. RGB sensors have a good benefit-to-cost ratio, that is, they allow the generation of spectral indices in the visible range and also allow to extract, from the geoprocessing software, other products such as digital terrain model (MDT), 3D model, orthomosaic images model, volume estimation, and accurate contours.

The advances achieved in recent years have created numerous possibilities of use, showing the importance of

https://dx.doi.org/10.22161/ijaers.69.5 *ISSN: 2349-6495(P) | 2456-1908(O)*

the technology for managing the resources used in the field. Therefore, the present study aimed to test the UAV platform coupled to a RGB sensor for monitoring a corn crop at different growth stages.

II. MATERIAL AND METHODS

The experimental area is located in the municipality of Coronel Pacheco-MG, at the José Henrique Bruschi Experimental Field (CEJHB) belonging to Embrapa Dairy Cattle (Figure 1). In this area, Fluvic Neosol (terrace) predominates, with flat relief and varied texture, which are typical of colluvial-alluvial floodplains. The relief forms of the municipality of Coronel Pacheco, MG, consist of 10% flat area, another 10% mountainous, and 80% undulating. The maximum and minimum altitudes are 1,070 m and 409 m, respectively. The municipal headquarters is at 484 m of altitude. The altitude of the corn planting area is around the minimum of the municipality (Figure 1).

The climate of the region is Aw, i.e., tropical with dry winter, according to the Köppen-Geiger classification. Based on the climatological normals of the National Institute of Meteorology (INMET) for the period 1981 to 2010, the average annual air temperature is 21.4ºC and the average annual precipitation volume is 1620.6 mm. The months of July (12.6 mm) and January (355.1 mm) have the lowest and highest rainfall, respectively.

Corn (hybrid RB 9308 VTPRO - Riber KWS) was sown on April 7, 2018. Planting was carried out at spacing of 80 cm between rows and 4.6 seeds per meter to establish a stand of 57.5 thousand plants per hectare, totaling about 310,000 seeds in the area of 5.39 hectares.

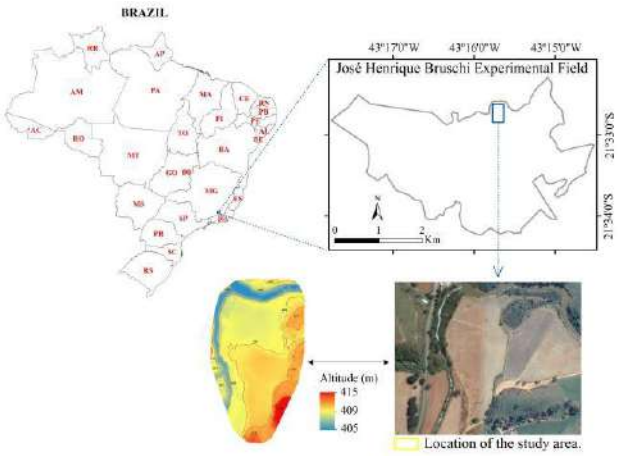

Fig. 1: Location of the study area in the José Henrique Bruschi Experimental Field (CEJHB), Embrapa Dairy Cattle, municipality of Coronel Pacheco, MG.

The aerial survey activities were carried out on April 26, 2018 and May 24, 2018. A rotary-wing UAV Inspire 1 Pro Quadcopter (Figure 2), with exchangeable cameras [from RGB (Red, Green, Blue) to multispectral sensors]. A RGB DJI Zenmuze X5 camera was used for imaging in the visible range. The high precision RGB sensors allowed the evaluation of the planting conditions through the procedures for quantitative measurement of vegetation and the qualitative evaluations through vegetation indices operating in the visible range of the electromagnetic spectrum.

Fig. 2: UAV Inspire 1 Pro flying over cultivated corn crop field. Photo: Marcos La Falce.

Flight plans were created following a standard technical compliance so that the survey results or products could be compared on a similar basis, equalizing variables such as flight height, ground sample distance (GSD), sensor calibration, percentage of image overlap, wind speed, brightness, shadow placement, time of day, angle of view, sun positioning, etc.

The flight plan parameters were set as follows: (i) 90 m flight height; GSD of 2.27 cm; maximum speed 15 m/s, flight time 9.5 minutes on battery use; images had 75% frontal overlap and 85% side overlap. Based on this flight plan configuration, 7 flight lines and 146 images were required to cover the entire area and subsequently generate the orthomosaic model using software Pix4D Mapper Pro 4.125.

Crop vigor, invasive plants, stand failures, and yield were analyzed using the selected vegetation indices according to characteristics and applicability of the visible spectrum Red-Green-Blue (RGB) bands.

Vegetation indices are widely used in studies to identify vegetation stress. These indices may thus assist in classifying targets, for example, separating normal developing vegetation from planting areas affected by pest, diseases, plant nutrient deficiencies, soil nutrient

https://dx.doi.org/10.22161/ijaers.69.5 *ISSN: 2349-6495(P) | 2456-1908(O)*

deficiencies, damage caused by wildlife such as capybaras (Hydrochoerus hydrochaeris), and others [5].

In the present study, we used the indices VARI (Visible Atmospherically Resistant Index [11]) and GLI (Green Leaf Index [12]) to indicate stress load of vegetation. VARI was developed to reduce possible influences of atmospheric effects by subtracting the blue channel band in the denominator of Equation 1. GLI (Equation 2) has been applied to distinguish photosynthetically active vegetation from dry vegetation with bare soil.

$$VARI = \frac{\rho_{Green} - \rho_{\mathrm{Red}}}{\rho_{Green} + \rho_{\mathrm{Red}} - \rho_{Blue}} \quad (1)$$

$$GLI = \frac{\left(2\,\rho_{Green} - \rho_{\mathrm{Red}} - \rho_{Blue}\right)}{\left(2\,\rho_{Green} + \rho_{\mathrm{Red}} + \rho_{Blue}\right)} \quad (2)$$

Where ρ_{Green}, ρ_{Red} and ρ_{Blue} are the spectral bands for the green, red, and blue channels, respectively.

III. RESULTS AND DISCUSSION

The vegetation indices showed the vegetation health and status of the plants at the imaging dates. The results on imaging using RGB cameras onboard the UAV platform are presented in this section. Each class interval defined for the vegetation indices had the area (ha) and the percentage (%) of cover estimated in relation to the total planting area.

As Table 1 shows, the VARI index had intervals of negative values in most of the area (~ 90%). The GLI index had only one class interval with negative values, however, it covered 1.38 ha or 25.58% of the total area. These results indicate little vegetation cover or wide bare soil area. On April 26, 2018, the corn crop was at 19 days after sowing, that is, between the second leaf (V2) and fourth leaf (V4) phenological stages. Subdivisions of the vegetative stages are designated as V1 through Vn, where n represents the stage with the last fully expanded leaf before Vt (tasseling) [13].

Figure 3A shows the mosaic of RGB images (visible bands). Areas with bare soil predominate. Corn planting rows start to appear in small areas on the north and south edges. The central region concentrates most of the negative values of class intervals for the VARI and GLI indices, with the yellow, orange, and red classes in the VARI index (Figure 3B) and the orange and red classes in the GLI index (Figure 3C). The indices indicate the nonuniformity of crop development from the early vegetative stages. In this case, it may have been influenced by water variability or the chemical and physical constituents of the soil. Soil analyses may clarify this issue.

Vegetation indices can assist in identifying areas of the crop with normal development or with some deficiency. According to Hunt Jr. et al. [12], vegetation indices have fundamental application in the extraction of information from remote sensing data; however, these methods can mitigate, but not eliminate, the effects of soils, topography, and view angle.

Table 1. Class intervals of vegetation indices VARI (Visible Atmospherically Resistant Index) and GLI (Green Leaf Index) with respective areas, as percentage, for the aerial survey on April 26, 2018

Class	Vegetation indices					
	VARI			GLI		
	Class intervals	Area (ha)	Percentage	Class intervals	Area (ha)	Percentage
	0.02 to 0.53	0.08	1.56	0.10 to 0.48	0.04	0.66
	-0.05 to 0.01	0.60	11.09	0.04 to 0.09	0.21	3.84
	-0.09 to -0.06	2.14	39.41	0.02 to 0.03	1.12	20.66
	-0.12 to -0.10	1.96	36.18	0.00 to 0.01	2.67	49.26
	-0.62 to -0.13	0.64	11.75	-0.27 to -0.01	1.38	25.58

The VARI and GLI vegetation indices calculated for the aerial survey carried out on 24/05/2018 showed positive class intervals in more than 85% of the planting area (Table 2). Of the total area (5.39 ha), only 13.13% (0.72 ha) and 14.78% (0.78 ha) were classified with negative intervals using the VARI and GLI indices, respectively.

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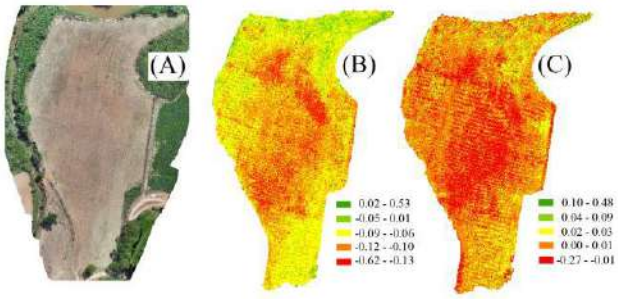

Fig. 3: RGB mosaic image (A) and class interval ranges for the vegetation indices VARI (B) and GLI (C), on April 26, 2018.

Table 2. Class intervals of vegetation indices VARI (Visible Atmospherically Resistant Index) and GLI (Green Leaf Index) with respective areas, as percentage, for the aerial survey on May 24, 2018

Class	Vegetation indices					
	VARI			GLI		
	Class intervals	Area (ha)	Percentage	Class intervals	Area (ha)	Percentage
	0.24 to 0.60	0.76	13.96	0.20 to 0.50	0.53	9.81
	0.18 to 0.23	1.70	31.14	0.16 to 0.19	1.12	20.50
	0.11 to 0.17	1.31	24.05	0.12 to 0.15	1.53	28.10
	0.02 to 0.10	0.97	17.72	0.07 to 0.11	1.49	27.31
	-0.21 to 0.01	0.72	13.13	-0.06 to 0.06	0.78	14.78

As can be seen in Figure 4A, the corn canopy has completely closed (47 days after sowing, between stages V8 and V9). However, stand failures are visible, especially in the middle of the area. Comparing the VARI (Figure 4B) and GLI (Figure 4C) maps clearly shows that GLI is more sensitive to green vegetation, which can be explained by the index formula, as the green spectral band has weight 2 relative to the blue and red bands. Thus, positive GLI values represent both green leaf and green stem characteristics.

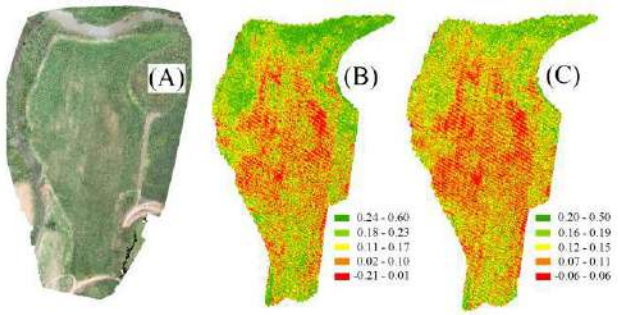

Fig. 4: RGB mosaic image (A) and class interval ranges for the vegetation indices VARI (B) and GLI (C), on May 24, 2018.

IV. CONCLUSION

The vegetation indices VARI and GLI showed similar performance in the initial vegetative stages of the corn crop. The indices were sensitive to class discrimination at intervals that indicate from bare soil and low vigor (shades of red, orange, and yellow) to the condition of high vegetation vigor (shades of green). Overall, the indices VARI and GLI appear as a potential alternative for crop monitoring using low cost RGB sensors onboard UAV platforms.

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https://dx.doi.org/10.22161/ijaers.69.6 ISSN: 2349-6495(P) | 2456-1908(O)

Using the Method of soil conservation service Curve Number (SCS-CN) Combined with the Geographic information system (GIS) to estimate the surface runoff on the Co To Island, North Vietnam

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Abstract— *Co To Island in the north of Vietnam is about 22 km^2 in area (including Big and Small Co To Islands), of which about 51% of mountainous and hilly areas, about 49% of cultivated land.On the island, there is only the meteorological observation station, no hydrological station. Because of the demand for water resources management, rainwater harvesting and storage needs initial hydrological parameters, this study first published the results of surface flow from rainwater on Big Co To Island.*

The authors used the Soil Conservation Services Curves Number method (SCS - CN) in conjunction with the Geographic Information System (GIS) to estimate surface flow parameters on Big Co To Island. Two types of rainfall monitoring data that have been exploited in this study are the average annual rainfall (Rainfall Eevent 1) and the amount of rainfall during the storms (Rainfall Events 2-4). Estimated results of Qo discharge flow rate reach 0.39 m^3/ s based on the 30-year rain monitoring data series with error less than 29%.

*The result of estimating the total surface water(*Wo*)generated from rain in event 1 was 13.1 x 10^6 m^3, meanwhile, during the rainy event 2 these values reached 10.2 x 10^6 m^3.This result confirms the potential of exploiting rainwater resources from storms on the island.SCS –CN method combined with GIS for determining exact areas, soil properties, land use ... has allowed the implementation of other calculations on the distribution of hydrological parameters at 14 sub-basins with different rain events.*

In the absence of any official statements about the hydrographic parameters of Big Co To Island, the findings of this study will be good references for other research and calculations involved.

The SCS - CN method combined with GIS is an effective and convenient tool to evaluate the hydrological parameters of water resources on the island, especially where there is no permanent hydrological monitoring station.

Keywords— Storm Rainfall, Surface flow, SCS - CN, GIS, Co To Island.

I. INTRODUCTION

Forecasting the surface runoff for a basin is very important in research and exploitation of water resources. There are quite a number of approaches to estimating surface flow, SCS - CN method that is one of the most widely used because of their simplicity and ease of use for practical. For each event, rainfall generates a certain amount of surface flow after loss of water surface and underground. Evaluation of surface water losses using traditional and latest methods combined with GIS has been mentioned in the works of Abhijit M.Zedel et al (2014), Geena GB et al (2011), Eljakeen M et al (2009) and Ningaraju et al (2016).Curve number (CN) is proportional to the surface flow quantity and inversely proportional to the permeability index of the soil. Curve number is a function of land use and hydrologic soil group (HSG).As such, the curvature index changes with the change in land use of the catchment area. Describing the properties of

https://dx.doi.org/10.22161/ijaers.69.6 *ISSN: 2349-6495(P) | 2456-1908(O)*

curve number as well as its variability with land use change has been mentioned by authors like Gandalia M et al (2014), Jeffry Swingly et al (2012) and in many another monographs.

In recent years, traditional SCS - CN method has been significantly enhanced with the development of satellite monitoring technology and geographic information systems. Data on soil properties and land use status have been evaluated for each group of hydrologic soil group (HSG). Therefore, the curve number (CN) is quantified and the results of surface flow estimates for each rainfall events are more accurate than other methods. Recent researches have confirmed that the SCS - CN method combined with GIS is highly effective in surface flow estimation, particularly for basins without a hydrological monitoring station. Modern GIS technologies have allowed to assess in detail the dimensions and angles of the basins, whether large or small. The geographical information system can retrieve and process the soil type and land use shapefiles and a new intersection shape file can be created as another data file for the curve number calculation. These types of studies have been mentioned by authors like Matej Vojtek et al (2016), Noah Kimeli et al (2017), Ningaraju H.J. et al (2016), Sameed Shadeed et al (2010).

Several other research teams use SCS - CN to evaluate the loss of rain for the SWAT and other model that calculates the potential for flooding from heavy rainfall events in the design of water protection projects. In the study of Sameed Shadeed (2010) also mentioned some other authors when simulate SWAT model used SCS -SN method to determine surface runoff as input for their model.

Improving the quality of SCS-CN calculation techniques is continuing to improve. Directions that enhance the accuracy of the SCS-CN method mainly take into account the distribution of CN in specified spatial regions, using a set of rainfall survey data in storms and surface runoff observations. Other authors have exploited the infiltration data and the soil moisture to correct the CN curve. Some other works focus on determining the correlation relationship between potential surface flow depth (S) with initial abstraction value. Studies using SCS -CN methods apply to different rainfall events in the basins with surface flow monitoring data and to basins where no hydrological monitoring stations have been mentioned in the works of Chow, V.T at al (1988), Jaehak Jeong et al (2010), Manoharan A (2012),H.J.Ningaraju et al (2016),Noah Kimeli (2017), Soulic K.X (2012) and Sameed Shadeed et al (2010).

The traditional method of SCS-CN in combination with GIS is still being exploited and researched to enhance the accuracy of the curve number (CN).Author Tomasz Kowalik et al (2015) used asymptotic function to evaluate CN.From the author's point of view, it is necessary to create many CN values as a function of rainfall depth and rainfall abundunce. In this study, the authors studied CN value distribution in 3 scenarios: scenario 1 is very large industrial value and very small depth of rain and concludes that CN value changes very little. The second scenario is when rainfall increases and the value of CN is unstable. The third scenario is that with many different depths of rain, the value of CN does not change unless the depth of rain is very small and the value of CN increases suddenly. The results of this study show that it can accept constant CN value for small basins.

Determining the coefficient λ in the formula point out the relationship between maximum potential water depth S (mm) and initial loss depth Ia depends very much on local conditions.However, in most related studies, the method of determining the coefficient λ is not indicated and selecting initial abstraction coefficientλ is only approximate.

The research direction of SCS -CN application in Vietnam is not much, however, it must mention the research works of Son Nguyen Thanh (2005) and An Ngo Le at al (2016), , in which they used surface runoff estimated by the SCS -CN method as input for SWAT model.

Before we started applying the SCS -CN method in combination with GIS onBig Co To Island conditions, we had a lot of difficulties. In addition to the limitations of the SCS -CN method as other authors mentioned above, estimating the surface flow value on Big Co To Island by SCS - CN method has its own difficulties.This has been confirmed by researchers on water resources in Viet Nam as well as in the study of Thong Bui Xuan et al (2017), Dan Nguyen Van, Thong Bui Xuan et al (2019).

Most of the islands in Viet Nam do not have hydrological stations, small areas, steep slopes, geological structure as well as terrain conditions are different, rivers and streams are very little so the determination of surface flow is very complex. So far, there has been almost no published information on surface flow in the islands including Co To Island. On Co To Island, there is a meteorological observation station currently exploiting daily rainfall data. However, there is no hydrological monitoring station on the island, so it is difficult to check the calculation results of the hydrological parameters. While the need to provide initial data on surface flow, total precipitation and other parameters of groundwater

https://dx.doi.org/10.22161/ijaers.69.6 *ISSN: 2349-6495(P) | 2456-1908(O)*

recharge on Big Co To Island is very urgent. We have chosen the simplest approach to apply the traditional SCS - CN method on the basis of fairly accurate assessments of land and land use in Big Co ToIsland to provide a set of parameters on water resources on the island.

Rainfall monitoring data on Co To Island with a continuous length of over 30 years is a reliable source to ensure the calculation of rainfall regime on the island. In this study, we have exploited two series of monitoring data of water flow in some streams on the island in September and October 2012 (Dan Nguyen Van, Thong Bui Xuan et al, 2019). This is a rare source of data that has been allowed to use in this study to evaluate the calculation error of the water flow value of Q_0 according to the SCS - CN method combining GIS with monitoring data at the same period.

One thing to emphasize in this study is that in the last 10 years GIS technology has been implemented very effectively in land use management and land classification on Co To Island. Due to the accurate GIS results, 14 sub-basins of Co To Island have been classified according to the actual use of land.Taking advantage of the results of GIS we exploited rain events corresponding to the average rainfall of 30 years (Rainfall event 1) and storm rainfall (Storm rainfall events) to calculate hydrological parameters for 14 basins of Big Co To Island.

As we are aware, the determination of Q_0 value of flow rate depends very much on the GIS results in accurately determining the area of sub-basins, slope, and types of land use. The value of Q_0 will be checked through the actual measurement results along with the allowable errors. If the value of Q_0 is evaluated with the permissible level, the other hydrological parameters will have a level of security.

RESEARCH AREA

Big Co To Island is one of the largest islands in the Co To archipelago and geographically locates at 21^0 00 ' N latitute and 107^0 15' E longtitude covering an area of 16.31 km^2. The population of Big Co To Island is estimated at 4,110 people in 2016(Year Book, Quang Ninh, 2013, 2016).Co To Island is low hills and mudflats. Mountainous areas cover about 51%. In the dense vegetation, natural forests and plantation forests cover the peaks and slopes. The cultivated land area occupies 49% of the natural area (Fig. 1).

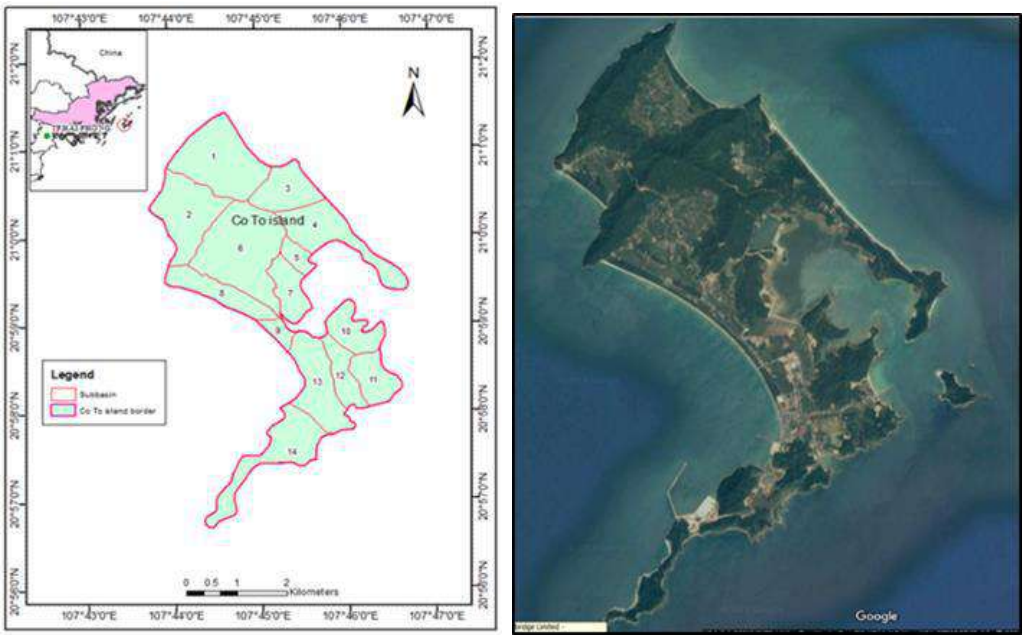

Fig.1: Location of Co To Island and sub-basins

Due to its small island nature, the potential for water resources is limited, while Co To is a tourist destination which attracts over 300,000 visitors every year. Therefore, the demand for water on the island is very high.In recent years, the situation has deteriorated due to the increase of salinity intrusion, pollution and exhaustion of surface water. Thus, the quantification of water resources with the objective of stability and economic development is a very necessary.Determining the characteristics of the total amount of water, groundwater or other features of the island water resources need to be appropriately formulated on the basis of available literature.

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On the Co To Island there is the only one marine meteorological tation with long observation data from 1958 up to now. The CoToMarine Meteorological Stationis 160 m above sea level and has coordinates at 20^0 59 ' N latitude and 107^0 46' E longtitude. The meteorological station belongs to the network of national monitoring stations should ensure the reliability used data in calculating water resources for whole CoTo Island.The Co To Island is located in the monsoon tropics with basic climatic characteristics as following.

- Temperature: The average annual air temperature on the island was about 23^0C,the lowest air temperature was 15^0Cin January and February, the highest average temperature in July was 28.6^0C. Generally the temperature is typical of marine climate, the amplitude of fluctuation is not large.

- Rainfall: The average annual rainfall is not high compared to many inland areas, the average rainfall was 1776 mm. The highest rainfall in 2013 was 2936 mm, the least rain in 1977 was 884 mm. The highest rainfall was from July to September and the least rainfall was from December to January.

- Wind: northeastward, prevailing from September to April. East wind from May to August, July alone South wind. Average wind speed was 4.2 m/s. Winter wind is stronger than summer. In about 100 years from 1895 to 1995, on average, 1-2 storms a year. Storm season from June to September, mainly from July to September.

- Average humidity was 84%, the lowest was about 23%.

- Evaporation: The average amount of evaporation was 954 mm. The months most evaporated from July to November, at least in February to March(Year Book, Quang Ninh, 2013, 2016). The climatic characteristics of Co To Island are summarized in Table 1.

- Co To island surface water resources: The aquatic ability on Co To island is quite large, but the ability to hold water is very poor due to the sloping topography, the water drains quickly to the sea, so the streams on the island are few. Water flow of streams depends on rainfall, there is no regular flow. The streams on the island have temporary water: the Hong Van streams, Nam Dong stream, Nam Ha stream, Hai Tien stream ... The Island has no natural lake but only artificial water reservoirs. The local government invested in building 6 freshwater lakes, of which Truong Xuan and C4 lakes supplied water to the town, the remaining lakes supplied water to agriculture.

Table 1. Climate characteristics of Co To Island in the period of 1977 -2016

Month/ Element	January	February	March	April	May	June	July	August	September	October	November	Dcember	Yearly
Rainfall (mm)	32.7	24.1	45.7	74.9	144.6	217.0	335.9	382.9	337.4	108.4	44.1	28.0	1776
Evaporation (mm)	70.4	45.1	46.9	51.2	66.5	73.4	86.6	77.0	91.0	122.0	116.2	107.5	954
Humidity (%)	83	88	90	90	88	87	85	86	82	78	76	78	84
Temperature (0^0 c)	15.1	15.2	18	22.1	26.2	28	28.6	28.3	27.4	25.1	21.4	17.5	23

II. MATERIAL AND METHOD

It can be said that the Soil Conservation Service (SCS) method originated in the early 1950s in United States of America. The original goal of this method is to evaluate the volume of direct runoff from rainfall.

Later, many improvements appeared to enhance the accuracy of determining the number of CN curves and from that method CN SCS is often applied to small basins in agricultural production. Until 1992, the CN SCS method was still considered the traditional method of determining the relationship between rainfall and surface flow. The method of SCS - CN has a long time of development and is widely applied in the world due to its simplicity and ease of application. GIS technology has strongly developed, soil properties, land use status, accuracy of land area with complicated angles has been quickly implemented by GIS with absolute accuracy. In general, SCS - CN method combined with GIS is the current method. Representatives for traditional SCS groups must include authors such as Chow, VT, Maidment, DR, and Mayse W (1988), Sheridan JM, and Marshall LK (2007), Professor Patel, United States Department of Agriculture (1986) and Varsha Mane, YB Katpatal, KR Aher (2014).

According to these authors, the SCS-CN method is based on the following principle. During a rainfall, the effective rainfall depth or the direct flow depth (Pe) never exceeds the rainfall depth (P). Similarly, after the flow of rainwater begins, the water depth is held in the basin,

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Continuous permeability depth (Fa) is always less than or equal to a certain depth of maximum potential water (S).

At the same time there is a loss of the initial loss depth (Ia) before runoff begins.Therefore, there is a potential flow of P - Ia.In the SCS method, assume that the ratio between the two real numbers Pe and Fa is equal to the ratio between the two potential quantities P - Ia and S, which means:

$$\frac{F_a}{S} = \frac{P_e}{P - I_a} \quad (1)$$

From the principle of continuous leading to the expression of total depth of rainfall P as follows:

$$P = P_e + I_a + F_a \quad (2)$$

From (1) and (2) the effective rainfall depth Pe:

$$P_e = \frac{(P - I_a)^2}{P - I_a + S} \quad (3)$$

In particular, P is the total depth of rainfall (mm), Pe is the effective rainfall depth (mm), Fa is the continuous permeability depth (mm), S is the maximum potential water depth (mm), I_a is the initial loss depth (mm).In the works ofSammeer SHADEED (2010), Ningaraju H.J. et al (2016),have shown that for the dry and semi – dried basins the value ofIa = 0.2S.So from (3) Pe is rewritten as follows:

$$P_e = \frac{(P - 0.2S)^2}{P + 0.8S} \quad (4)$$

Plotting relationships between P and Pe using data from multiple basins has found their standardized CN curves.CNis a dimensionless integer, taking a value in the range $0 \leq CN \leq 100$.A CN of 100 represents a limiting condition of a perfectly impermeable catchment with zero retention, in which all rainfall becomes runoff. For natural basins, CN <100. The curve number CN is estimated using antecedent moisure condition (AMC) and hydrological soil group (HSG).

The variable S, which varies with antecedent soil moisure and other variables, can be estimated as

$$S = 25.4\left(\frac{1000}{CN} - 10\right) \quad (5)$$

Where S is the spatial variation of the soilaccording to changes in soilproperties, land use and management, slope and time.

The CN is calculated based on the weighted average of the land use types present in the basin:

$$CN = \frac{(CN_1.A_1) + (CN_1.A_1) + (CN_1.A_1) + \cdots + (CN_n.A_n)}{\sum_{i=1}^{n} A_i} \quad (6)$$

Where A_1, A_2, A_3 ... A_n is the area of land types in the basin with CN_1 CN_2 , CN_3, ..., CN_n respectively.A_i is the total area of the basin. Table 2 summerizes the HSG characteristics.The conditions for moisture classification according to SCS are shown in Table 3.

The combination of GIS in SCS-CN method is described as follows. Land use and soil type shapefiles were first obtained and compiled in a GIS Data base. Soil properties and land use themes were intersected using GIS techniques, to generate new and smaller polygons associated with hydrological soil group (HSG_s) and land use cover names. At the same time the curve number database was built based on the intersected land soil layer and its related common table. All the field calculator combined with GIS techniques were presented on methodology scheme 2 below.

Table 2. Classification of hydraulic conductivity of soil group (HSG) according to SCS

Soil group	Lowest permeability rate (mm/hour)	Description
A (High infiltration)	7.62÷11.43	Types of soil with high sand and gravel. Low erosion potential
B(Moderate infiltration)	3.81÷7.62	Soils with fine and coarse grains are balanced
C (Low infiltration)	1.27÷3.81	Soil types have a lot of fine grains. High erosion potential
D(Very low infiltration)	0 ÷ 1.27	Soil types with very high clay content, static groundwater levels are often high, that is, valley and clay soil near the surface. Very high erosion potential.

Table 3. AMC moisture conditions for determination of CN

Antecedent Moisure Condition AMC	Description	Conversion of CN from AMC II to I and III	Total Rain in Previuos 5 Days (mm)	
			Dormant Season (mm)	Growing Season (mm)
I	Dry conditions	$CN(I) = \frac{4{,}2CN(II)}{10 - 0{,}0568CN(II)}$	< 13	< 36

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II	Normal moisture conditions		13÷28	36÷53
III	Wet conditions	$CN(I) = \frac{23CN(II)}{10 + 0{,}13CN(II)}$	> 28	> 53

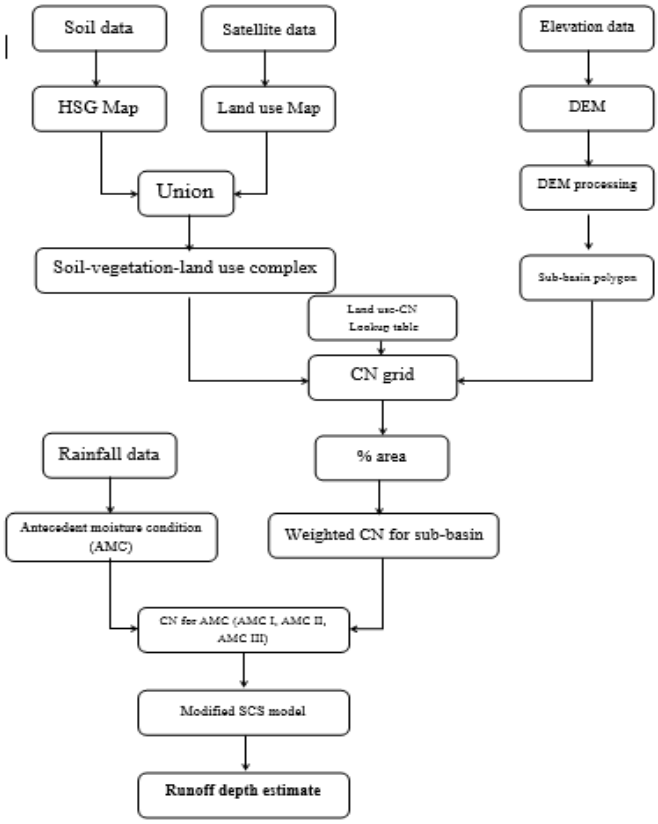

Fig.2: Scheme of surface runoff estimation by SCS - CN method combined with GIS

III. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Data used

Data on land and land use of BigCo To Island are presented in Table 4 and Table 5 and on Figures 4. Data on topography and slope of the island are shown in Figure 3 below.

+ 1/10,000 scale topographic map is digitized into 30 m x 30 m digital elevation map (DEM). From the topographic map, it is possible to determine the slope of the Big Co To Island topography. Grading of slopes in the range of <10%, 10-20%, > 20% shows that the topographic area is <10% (has the nature of the delta) occupying more than 60% of the total area.

+ The land map was extracted from the national atlas of 2000. According to FAO land classification, the whole land on Big Co To Island is ferralitic gray soil corresponding to land type B according to the HSG classification (Table 2).

+ Land use map extracted from the results of interpretation from Landsat 7 satellite imagery taken in 2015. The results of the classification according to different types of land use showed that there are 8 main land use categories, of which land grassland occupies the highest rate of 48.5%, followed by bare mountain land accounts for 24.6%.

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Table 4. Summary of spatial data of Big Co To Island

Number	Type of data	Amount	Source	Year
1	Topographic map of the scale of 1 / 10,000	Whole island	Department of Surveying and Mapping - Ministry of Natural Resources and Environment	2009
2	Landuse map	Whole island	https://earthexplorer.usgs.gov/ Landsat 7 ETM + C1 Higher-Level	2015
3	Soil map	Whole island	Atlas	2000

Table 5. Total area of land use types of BigCo To Island

Number	Type of land use	Land code (According to FAO 74)	Area (ha)	Area (%)	CN (Land type B, AMC II)
1	Residential land	URBN	86.2	5.3	85
2	Land Stone bald	BARR	401.3	24.6	86
3	Grassland	GRAS	790.8	48.5	79
4	Land for planting fruit trees and perennial trees	ORCD	6.0	0.4	65
5	Flooded land	WATR	171.7	10.5	100
6	Forest land planted	FRST	70.7	4.3	66
7	Fixed upland fields	AGRL	29.4	1.8	75
8	Land Planting rice	RICE	74.5	4.6	78
Total			1631	100	

The series of continuous rainfall monitoring data (Rainfall event 1) in the period of 1977 -2016 and 4 storm rainfall events (Storm rainfall events 2,3, 4 and 5) in the period 2013-2016 were collected to calculate surface flow and othehydrological parameters on the Big Co To Island. Four storm events with corresponding type III moisture conditions (with the preceding 5-day precipitation greater than 53 mm), thereby determining the CN III value. Table 6 below summarizes the characteristics of 4 storm rainfall events.

Table 6.Characteristics of storm rainfall events onBig Co To Island

Storm rainfall Event	Time period	Amount of rainfall (mm)	Number of hours	Average rainfall intensity (mm/h)	Five-day antecedent rainfall (mm)	AMC
2	3-5/9/2013	652.4	72	9.06	109.6	III
3	20-21/8/2014	227.3	48	4.74	182.6	III
4	2-4/9/2015	287	72	3.99	86.7	III
5	5-6/7/2016	313.6	48	6.53	78.1	III

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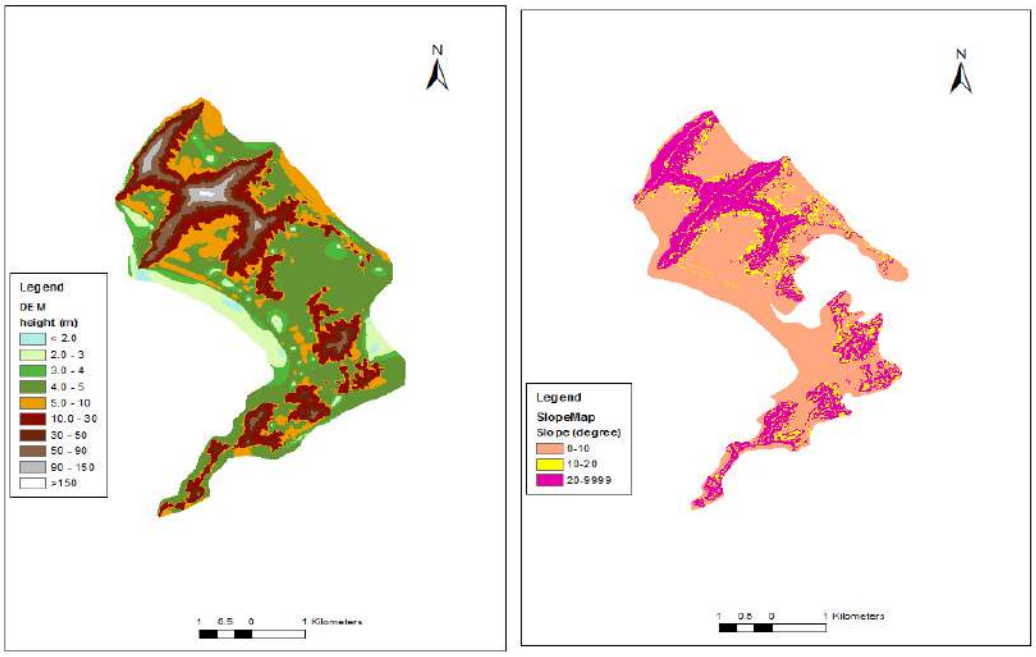
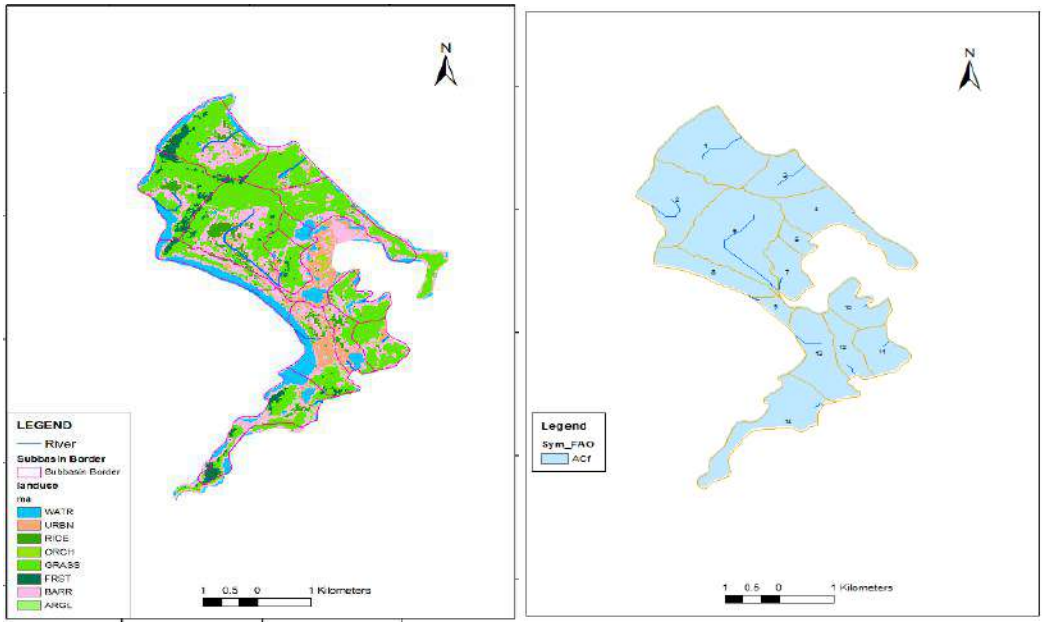


(a) ***(b)***

Fig.3: Topographic map (a) and slope (b) of Big Co To Island



(a) ***(b)***

Fig. 4: Map of land use status (a) and soil properties (b) of Big Co To Island

3.1.2. Sub-basins

From topographic map combined with the existing river and stream network on the island, the Big Co To Island is divided into 14 sub-basins according to independent water sources to evaluate water resources parameters (Dan Nguyen Van, Thong Bui Xuan et al 2019). Combined with the land use map to determine the area of land use types in the sub-basins.The coastal sub-basins are mostly small areas and are watery lagoons. The results of determining soil types of 14 sub-basins are shown in Table 7.

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Table 7. Area of land types in sub-basins of Big CoTo Island

Sub -basins	Type of land use								Total F (km^2)
	BARR	WATR	GRASS	FRST	URBN	ARGL	RICE	ORCH	
1	0.58	0.19	1.11	0.17	0.04	0.01	0.08	0.00	2.18
2	0.27	0.18	0.93	0.20	0.01	0.01	0.08	0.00	1.68
3	0.12	0.02	0.80	0.01	0.03	0.01	0.01	0.00	1.00
4	0.35	0.08	0.96	0.00	0.04	0.01	0.01	0.01	1.46
5	0.07	0.08	0.15	0.00	0.00	0.00	0.00	0.00	0.31
6	0.81	0.01	1.42	0.09	0.08	0.03	0.29	0.01	2.74
7	0.17	0.01	0.47	0.02	0.03	0.00	0.01	0.00	0.71
8	0.28	0.27	0.21	0.04	0.03	0.01	0.04	0.00	0.88
9	0.07	0.12	0.01	0.00	0.02	0.01	0.00	0.00	0.23
10	0.21	0.06	0.42	0.00	0.02	0.04	0.02	0.01	0.77
11	0.16	0.00	0.50	0.00	0.04	0.03	0.01	0.01	0.74
12	0.19	0.08	0.14	0.00	0.15	0.03	0.07	0.00	0.65
13	0.33	0.30	0.31	0.03	0.33	0.06	0.08	0.01	1.44
14	0.42	0.32	0.46	0.16	0.04	0.05	0.05	0.01	1.52
Total F (km^2)	4.01	1.72	7.91	0.71	0.86	0.29	0.74	0.06	16.31

3.1.3. Determine the average CN value of sub-basins

The average CN value of the basin is determined by weighted average according to the area of different types of land use in the basin.Based on the land use classification table of each basin (Table 7) and CN II value (Table 5),the average CNII value of sub-basins is determined as shown in Table 8.The values of CN I and CN III are converted from CNII according to the formula mentioned above.In Table 8 we can see that in the coastal sub-basins, the CN curve number is often very high (Sub-basin 9).

Table 8. Average CN values of each sub-basin by three moisture content (AMC)

AMC/Sub- basins	I	II	III
1	65.2	81.7	91.1
2	63.9	80.8	90.7
3	63.1	80.3	90.3
4	65.4	81.8	91.2
5	72.1	86.0	93.4
6	63.7	80.7	90.6
7	63.9	80.8	90.6
8	74.2	87.2	94.0
9	83.7	92.4	96.6
10	66.4	82.4	91.5
11	63.4	80.5	90.5
12	69.7	84.5	92.6
13	71.8	85.9	93.3
14	68.5	83.8	92.3
Average	68.2	83.5	92.1

3.1.4.Determine moisture conditions

Based on the total rain in previuos 5 days and the AMC classification table (Table 3), the corresponding moisture conditions of categories I, II and III(AMCI, AMCII and AMCIII) were determined. The growing season on Co To Island was chosen as the rainy season and that starts from May to October.

3.1.5.Determine CN value corresponding to moisture conditions

The value of the CN curve corresponding to the humid conditions I, II and III (CN I, CN II, and CN III)

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was determined corresponding to the previous 5 day humidity conditions.The results of estimating CN curve values were presented in Table 8.

3.1.6.Determine the value of maximum potential water depth S (mm) and initial water loss depth Ia (mm)

Based on CN values according to the corresponding moisture conditions, determine S value according to formula (5).From S value, Iaparamerwas determined. In some studies of applying SCS method in Vietnam to coastal areas with high mountainous terrain such as the authors of An Ngo Le et al (2016), Son Nguyen Thanh (2005) used Ia = 0.1S. Considering that on Co To Island, there were similar terrain conditions, we selected Ia = 0.1S.

3.1.7.Results of calculation of surface runoff characteristics according to selected rainfall events

The relationship between the average annual rainfall and the average depth of the annual flow in the period of 1977-2016 was shown by the correlation coefficient $R^2$and this coefficient reaches the value of 0.94. This result showed very good relationship between total rainfall and flow depth of the same period. The years with high rainfall will have a high flow depth and vice versa (Fig. 6 and Fig. 9).

+ At rainy event 1, conduct calculations with the entire series of rainfall data from 1977-2016 to identify Pe,W_0, Q_0, C_0values. The calculation results were presented in Table 9. In addition, the monthly distribution results of the flow depth Pe of the sub basins are shown in Table 10.

+ At storm rainfall events 2, 3, 4 and 5, calculations were done according to storm parameters as shown in Table 6 above. Four storm rainfall events were selected in the last 4 years from 2013-2016.

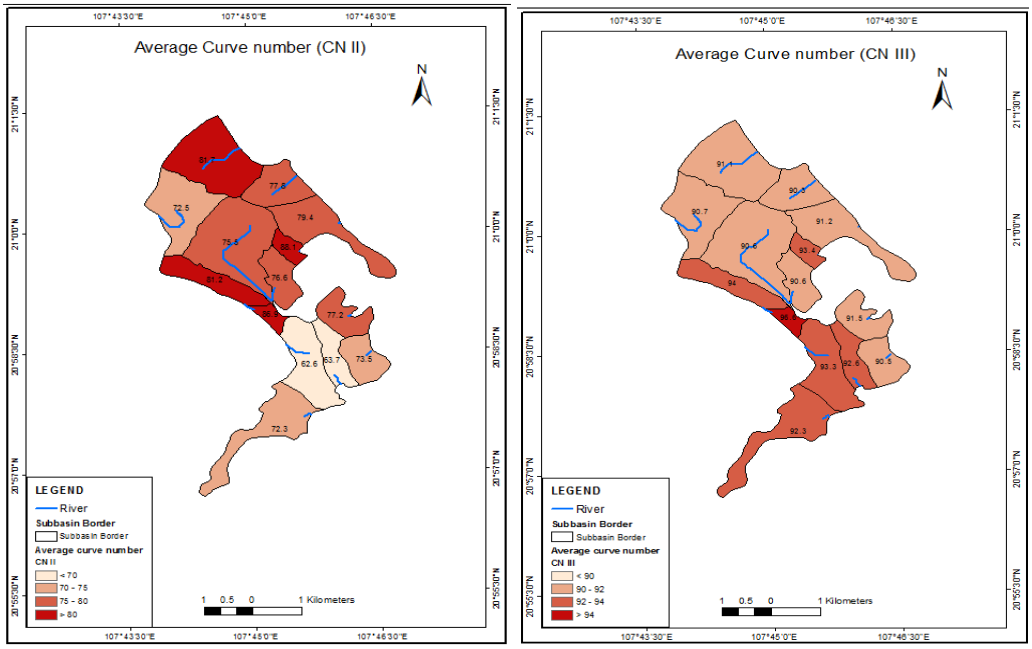
Results calculated values of S (mm), Ia (mm), Pe (mm) and W_0 (x $10^6 m^3$) of 4 storm rainfall events are presented in Table 11 below.In these storm rainfall wet conditions were determined under AMC III moisture conditions.

+ Value Q_0 cannot be calculated for storm rainfall events.

A summary of the results of estimating water resource parameters corresponding to the rain events was presented in Table 12 below.In section 4.8 below we will try to analyze the calculated results.

3.1.8.Spatial and temporal distribution of hydrological parameters on Big Co To Island

The results of estimating number of CN curves in different moisture conditions were shown in Tables 8 and Table 9 and Figure 5. The average value of CN II corresponding to rainfall event 1 was83.5 (Table 8 and Table 9). The average value CN III corresponds to rainfall event 2 as 92.1 (Table 8).



(a) ***(b)***

Fig.5: Average number of curves CN II (a) and CN III (b)on sub-basins

Here are some comparative remarks between the hydrological parameters of the average annual rainfall event and the storm rainfall events. Storm rainfall event 2 had the highest flow coefficient of 0.96 and the highest intensity of rain was 9.06 mm/hour and of course the maximum flow was 10.2 x 10^6 m^3 (Table 6, Tables 11 and 12). The heavy rain event number 3 had the lowest rainfall intensity of only 3.99 mm / hour, the flow

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coefficient reached the value of 0.94 and so the total flow was only the lowest value of 3.3 x 10^6 m^3.What needs to be emphasized here is that with heavy rain events such as rain event 2, the total flow is quite large at10.40 x 10^6 m^3whileat the rainy event 1 from the average annual rainfall gave a total flow of only 13.1 x 10^6 m^3.However, the potential maximum depthS (mm) of the storm rainfall event 2 was very low compared to this value of the rainfall event 1. This conclusion is in our opinion very complementary to the management of water resources on the island.The results of rainfall and surface flow were shown in Figure 6 and Figure 9.

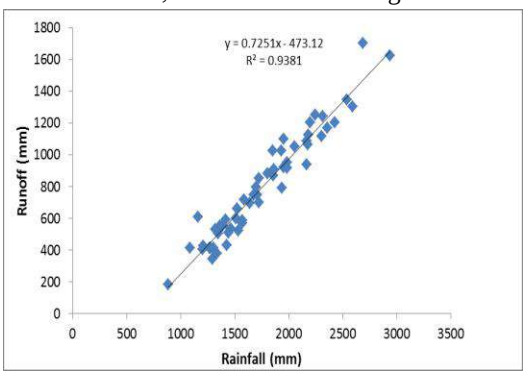

Fig. 6: Runoff- rainfall relationship for Co To Island

Total annual flow generated from rainfall event 1 in sub-basins 1, 2, 4, 6, 13 and 14 were higher than that of other sub-basins, of which the total surface water volume in the sub-basin 6 was the highest with a value of2.07 x 10^6 m^3 /year and total surface water reached the lowest value in sub-basin 9 with a value of only 0.26 x10^6 m^3 / year (Table 9).For storm rainfall events the distribution of volume water surfaces in the space of 14 sub-basins also shows the similarity of rainfall event 1.

Sub-basin 6 was a place with very low permeability coefficient and the lowest number of CN (CN II was 80.7, CN III was 90.6), so in this basin, the value of surface water volume obtained from rainwater Wo in both rainfall event 1 and storm rainfall event 2 were of the highest value (Wo of rainfall event 1 was 2.07 x x 10^6 $m^3$and storm rainfall event 2 is worth 1.75 x 10^6 m^3(Table 9 and 10).

In contrast, sub-basin 9 is the basin bordering the tidal flood waters and here the CN II and CN III were very high, so the total surface water received from rain water Wo reaches the lowest value among 14 sub-basins.

A conclusion can be drawn as follows. The distribution of the hydrological parameters on the island in the rain events shows the general hydrological rule of small basins with different water permeability. During storm events even though the total volume of surface water from rainwater reaches a high value, the maximum potential water depth is not higher than the maximum potential depth of the average annual rainfall event.

Table 9. Distribution of water resources characteristics according to the rainfall event 1 in the Co To sub-basins

Sub -basins	P (mm)	Pe (mm)	CNII	Qo (m^3/s)	Wo (10^6 m^3)	C_O=Pe/P
1	1776	777.2	81.7	0.05	1.69	0.44
2	1776	757.0	80.8	0.04	1.26	0.43
3	1776	743.7	80.3	0.02	0.75	0.42
4	1776	780.6	81.8	0.03	1.14	0.44
5	1776	893	86.0	0.01	0.27	0.50
6	1776	753.3	80.7	0.06	2.07	0.42
7	1776	756.1	80.8	0.02	0.53	0.43
8	1776	931	87.2	0.02	0.82	0.52
9	1776	1128	92.4	0.01	0.26	0.64
10	1776	796	82.4	0.02	0.61	0.45
11	1776	749	80.5	0.02	0.56	0.42
12	1776	851	84.5	0.02	0.56	0.48
13	1776	888	85.9	0.04	1.28	0.50
14	1776	832	83.8	0.04	1.26	0.47
Average	1776	831.1	83.5	0.03		0.47
Total				0.39	13.1	

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Table 10. Results of calculation of surface flow characteristics according to 4 storm rainfall events on the sub-basins of Co To Island

Sub-basin	CNIII	S(mm)	Ia(mm)	Event /Pe (mm)				Event/Wo x 10^6 m^3			
				2	3	4	5	2	3	4	5
1	91.1	24.8	2.5	637.8	213.1	273.1	299.2	1.39	0.46	0.59	0.65
2	90.7	26.2	2.6	637.0	212.3	272.3	298.4	1.06	0.35	0.45	0.50
3	90.3	27.2	2.7	636.4	211.8	271.7	297.9	0.64	0.21	0.27	0.30
4	91.2	24.5	2.5	637.9	213.2	273.2	299.4	0.93	0.31	0.40	0.44
5	93.4	18.0	1.8	641.8	216.9	276.9	303.1	0.20	0.07	0.08	0.09
6	90.6	26.4	2.6	636.8	212.2	272.1	298.3	1.75	0.58	0.75	0.82
7	90.6	26.2	2.6	636.9	212.3	272.2	298.4	0.45	0.15	0.19	0.21
8	94.0	16.2	1.6	642.8	217.9	277.9	304.1	0.57	0.19	0.25	0.27
9	96.6	9.0	0.9	647.0	222.0	282.0	308.2	0.15	0.05	0.07	0.07
10	91.5	23.5	2.4	638.5	213.8	273.8	299.9	0.49	0.16	0.21	0.23
11	90.5	26.7	2.7	636.6	212.0	272.0	298.1	0.47	0.16	0.20	0.22
12	92.6	20.2	2.0	640.4	215.6	275.6	301.8	0.42	0.14	0.18	0.20
13	93.3	18.2	1.8	641.6	216.7	276.8	302.9	0.92	0.31	0.40	0.44
14	92.3	21.3	2.1	639.8	215.0	275.0	301.2	0.97	0.33	0.42	0.46
Average	92.1	22.0	2.2	639.4	214.6	274.6	300.8				
Total								10.4	3.5	4.5	4.9

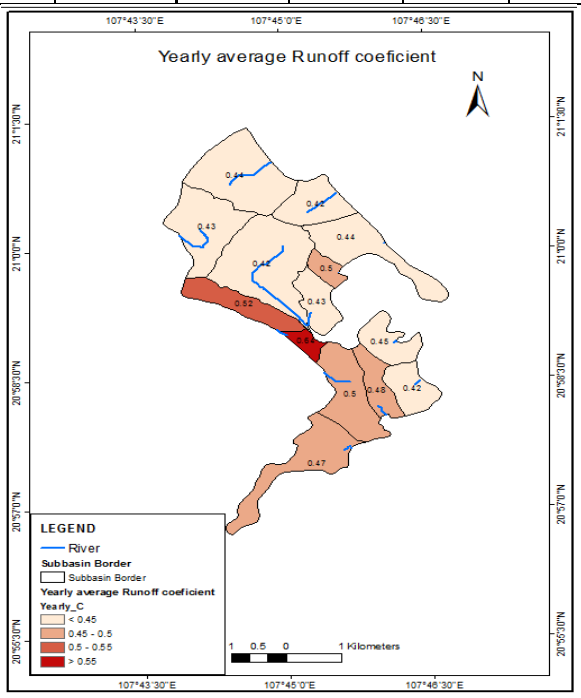

Fig.7: Annual mean flow coefficient C_0 of sub-basins

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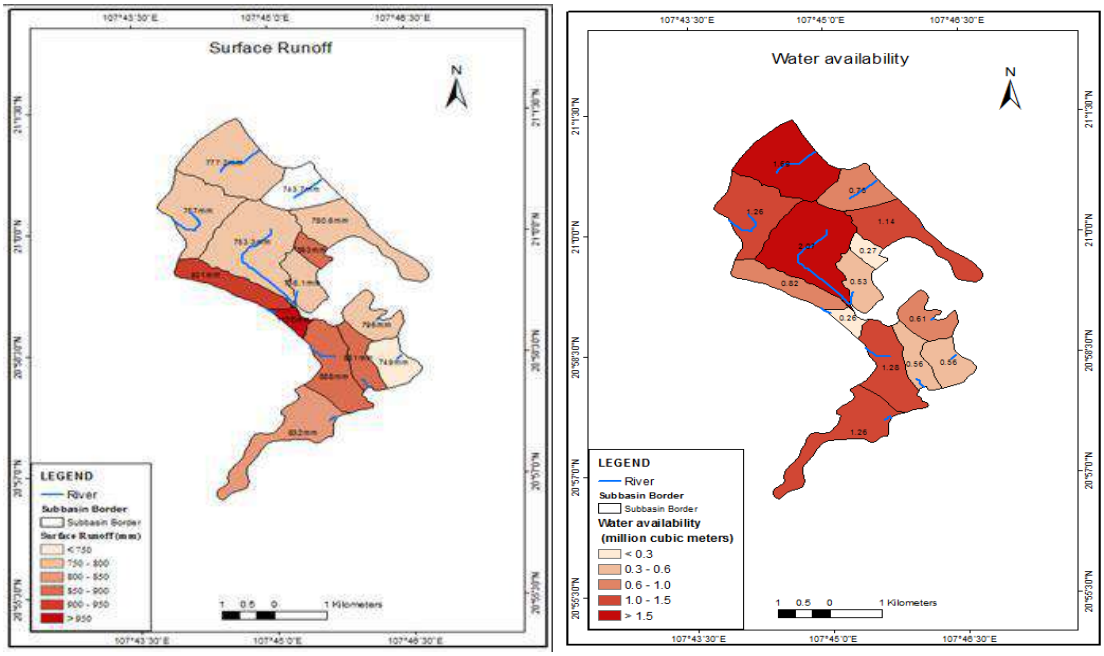

a) ***b)***

Fig.8: Surface runoff (a) andtotal annual average water volume (b) on sub-basins

In the first rain event with 30-year rainfall data we made calculations of the discharch flow valueQo (m^3/s) and distributed the average flow depth layers Pe (mm) of months (Table 9 and Table 11).

Table 11. Monthly distribution of the depth of the flow layer Pe(mm) in the sub-regions of the rainfall event 1

Month/ Sub- basins	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Pe (mm)
1	7.2	1.2	7.8	18.7	46.4	98.7	164.0	205.1	172.1	38.7	11.5	5.9	777
2	6.9	1.1	7.5	17.8	44.5	95.9	160.5	200.5	168.3	37.5	10.9	5.6	757
3	6.8	1.0	7.3	17.3	43.3	94.0	158.1	197.5	165.7	36.7	10.6	5.4	744
4	7.2	1.2	7.9	18.8	46.7	99.1	164.6	205.9	172.7	38.9	11.6	5.9	781
5	8.6	1.9	9.9	23.9	57.2	114.8	183.9	231.0	193.4	46.0	14.8	7.8	893
6	6.9	1.1	7.5	17.7	44.2	95.4	159.8	199.7	167.6	37.3	10.8	5.5	753
7	6.9	1.1	7.5	17.8	44.5	95.8	160.3	200.3	168.1	37.4	10.9	5.6	756
8	9.1	2.1	10.6	25.6	60.7	120.0	190.2	239.1	200.1	48.4	15.9	8.5	931
9	12.1	4.1	14.8	35.6	80.1	147.7	222.3	280.2	233.9	62.1	22.6	12.4	1128
10	7.4	1.3	8.2	19.5	48.1	101.2	167.2	209.4	175.5	39.8	12.0	6.2	796
11	6.8	1.0	7.4	17.5	43.8	94.8	159.1	198.7	166.8	37.0	10.7	5.5	749
12	8.1	1.6	9.1	21.9	53.1	108.9	176.7	221.6	185.7	43.3	13.5	7.1	851
13	8.6	1.8	9.8	23.6	56.7	114.2	183.1	230.0	192.6	45.7	14.7	7.7	888
14	7.8	1.5	8.8	21.1	51.4	106.2	173.5	217.5	182.2	42.1	13.0	6.7	832
Average	7.9	1.6	8.9	21.2	51.5	106.2	173.1	216.9	181.8	42.2	13.1	6.8	831.1

In the rainfall event 1, the results of the distribution of the average monthly flow in the whole island showed that the flow layer began to increase from May, the highest in August every year and gradually decreased in October (Table 11, Figure 9).

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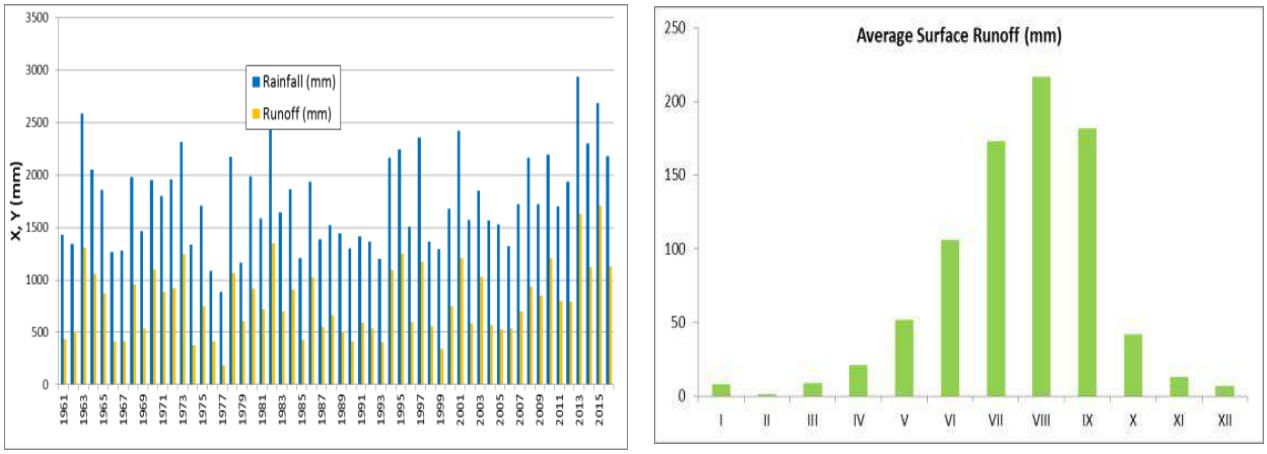

a) *b)*

Fig. 9:Annual rainfall (a) and monthly distribution of surface runoff (b) in the period of 1977-2016 on Co To Island

As mentioned above, sub-basin 9 is a coastal marsh, small area, the CN II curve coefficient was quite high, so here the depth of the flow layer Pe (mm) always reached the highest value compared with in the months of the year (Table 11).

Table 12. Summary of water resource calculation results corresponding to rainfall events

Event	P (mm)	$CN_{ave.}$	S (mm)	Ia (mm)	Pe (mm)	Wox 10^6 m^3	C_O=Pe/P
1	1776	83.5	50.2	5.0	831.1	13.1	0.47
2	652.4	92.1	22	2.2	626.7	10.4	0.96
3	227.3	91.5	24	2.4	213.8	3.5	0.94
4	287.4	91.5	24	2.4	273.8	4.5	0.95
5	313.6	91.5	24	2.4	299.9	4.9	0.96

Table 13. Estimated results of Q_0 by SCS - CN method and observed data Q_0 in sub-basins 1, 2, 3, 4, 6 and 12 on Co To Island in September, October

Basin	Area (km^2)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Qo (m^3/s)	Observed in Sep (m^3/s)	Observed in Oct (m^3/s)
1	2.17	0.01	0	0.01	0.01	0.01	0.09	0.1535	0.184	0.083	0.06	0.01	0	0.05	0.065	0.07
2	1.67	0	0	0	0.01	0.03	0.13	0.186	0.12	0.014	0.0126	0.01	0	0.04	0.01	0.01
3	1	0	0	0	0.01	0.02	0.03	0.08	0.07	0.04	0.01	0	0	0.02	0.03	0.01
4	1.46	0	0	0	0.01	0.02	0.05	0.04	0.11	0.09	0.0116	0.01	0	0.03	0.07	0.01
5	0.31	0	0	0	0	0.01	0.01	0.06	0.03	0.02	0.01	0	0	0.01	-	-
6	2.74	0.01	0	0.01	0.02	0.08	0.05	0.1	0.4	0.026	0.0094	0.01	0.01	0.06	0.02	0.01
7	0.71	0	0	0	0	0.01	0.02	0.06	0.05	0.04	0.01	0	0	0.02	-	-
8	0.88	0	0	0	0.01	0.02	0.04	0.06	0.08	0.06	0.02	0	0	0.02		
9	0.23	0	0	0	0	0.01	0.01	0.06	0.02	0.02	0.01	0	0	0.01		
10	0.77	0	0	0	0.01	0.01	0.03	0.06	0.06	0.05	0.01	0	0	0.02		
11	0.74	0	0	0	0	0.01	0.02	0.06	0.05	0.04	0.01	0	0	0.02		
12	0.65	0	0	0	0	0.01	0.02	0.06	0.05	0.04	0.04	0	0	0.02	0.04	0.032
13	1.44	0	0	0.01	0.01	0.03	0.06	0.06	0.12	0.1	0.02	0.01	0	0.04		
14	1.52	0	0	0	0.01	0.03	0.06	0.06	0.12	0.1	0.02	0.01	0	0.04		
Total	16.31	0.04	0.01	0.05	0.11	0.28	0.58	0.06	1.23	1	0.24	0.07	0.04	0.39		

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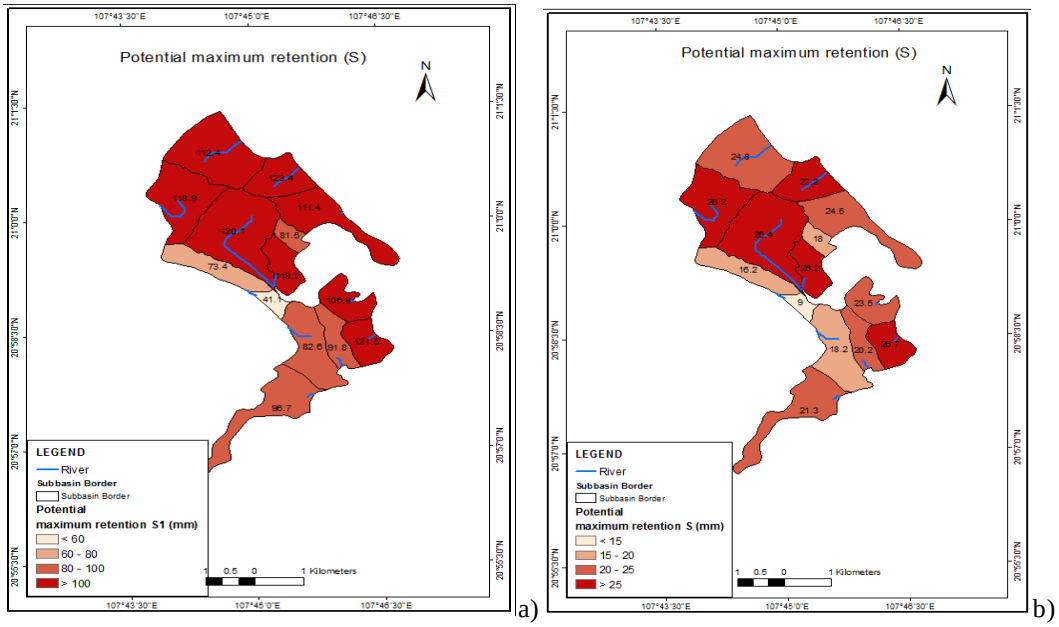
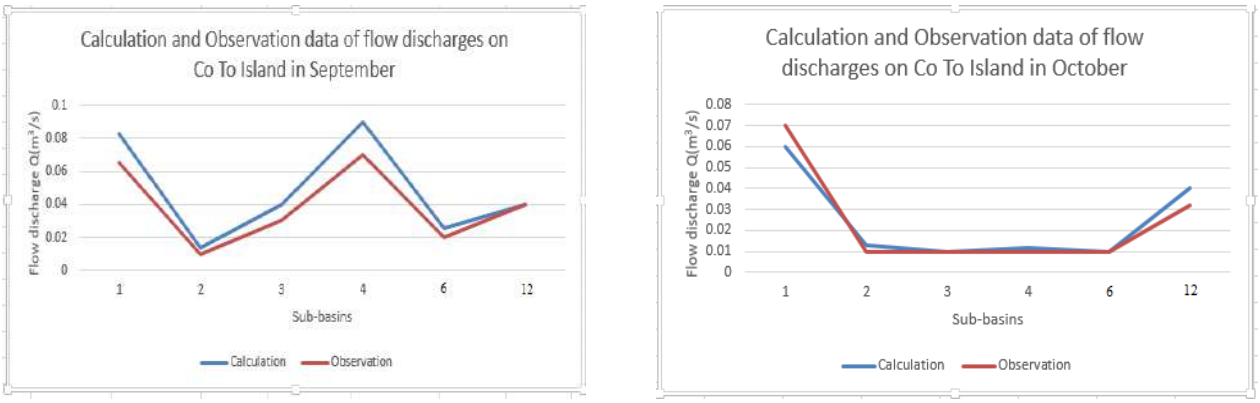


a) b)

Fig.10: Maximum potential water storage (S) on the Co To sub-basinsat rainfall event 1 (a) and in storm rainfall events 2, 3,4,5 (b).

The calculation error of September ranged from 20 to 29%, while this value in October was lower, only fluctuated between 6 - 21%



a) *b)*

Fig. 11: Comparison of estimated results Q_0 by SCS – CN method combining GIS with observed data on Co To Island. a) For September, b) For October

3.2. Discussion

Research on island hydrology is a very new issue in Vietnam. Published documents on water resources in general and hydrological parameters on the island are very limited. On the island, there are no fixed stations for hydrological monitoring, and the discharge monitoring data are also very rare. In such difficult conditions, the need to provide information for water exploitation management on the island is very urgent, in this study we want to confirm that our calculation results are based on scientific basis.

1. SCS - CN method combined with GIS has advantages and disadvantages when applied to island conditions. Traditional SCS - CN method and today with the support of GIS technology has been confirmed as a convenient method to identify water resources parameters of small basins with different geological structures and terrain. However, almost no research has applied the SCS - CN method for island conditions. There are very few studies applying SCS - CN method combined with GIS for coastal basins, where hilly and mountainous terrain and part plain. We believe that with the results of applying SCS - CN method in such basins, it will be suitable with the climate and terrain conditions of the island.

2. We followed closely the guidelines of using SCS –CN method combined with GIS technology to estimate the hydrological parameters of Co To Island. The reasonable distribution of hydrological parameters in the

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14 sub-basins with accurate data on soil type, land use, slope as well as permeability of each sub-basin has shown the calculation results is a scientific basis. The results of applying SCS - CN method combined GIS for rainfall event 1 and storm rainfall events (Storm rainfall event 2) showed a reasonable distribution ofhydrological parameters of Co To Island condition. The value of the discharge rate Qo calculated for September and October has been verified by observed data at 6 sub-basins showing that the error was not more than 29%. The calculated Qo value was always higher than the actual observed value. The Qo error assessment results allow us to believe that other hydrological parameters can be used for other research purposes on water resources on Co To Island.

3. The set of 30-year continuous rainfall monitoring data at the island's meteorological observation station and the latest data on soil quality, land use and detailed terrain for 14 sub-basins were assessed with the high precision. This has increased the accuracy of the calculation results of the hydrological parameters on the island.

4. In the study of water resources of Co To Island, we have experimented to exploit SWAT model, but the results are still very limited. Due to the lack of long-term observing of the flow discharge on the island, the application of the Soil Water Assessment Tool (SWAT) to evaluate water resources parameters on the island is also difficult. The process of using a basin similar to Co To Island to calculate the hydrological parameters on the island was a major limitation that reduces the accuracy of the actual hydrological parameters of the island. It is for this reason that we have decided in the long run to use the SCS - CN method that incorporates GIS technology to be the only effective solution to assess the parameters of water resources on the island. This conclusion has set out a task to strengthen research on the SCS-CN method to further improve the accuracy of the island's hydrological parameters. At the same time, it is necessary to add monitoring data on flow, surface runoff and other hydrological parameters to verify and caribration of calculation results according to model types.

IV. CONCLUSION

This is the first time we have published the hydrological parameters of Co To Island. This set of parameters is the result of applying SCS - CN model combined with GIS techniques based on exploiting the series of 30-year rain monitoring data along with accurate data on land and land use of the island.

The results included: total surface water from rainfall W_0 = 13.6 x 10^6 m^3/year, surface flow depth (Pe) and maximum potential storage depth was estimated with values of 831.5 mm and 50.2 mm. At the same time other hydrological parameters such as flow rate Q_0, surface flow coefficient C_0were determined to be 0.39 m^3/s and 0.47 m^3/s respectively. These are necessary results on the water resources parameters on Co To Island.

SCS - CN method combined with GIS is also applied to storm events, this estimation result also show that the surface potential water from storrm on the island is very large despite the maximum potential water depth S of storm rainfall events are not large, even less than half of the maximum potential water depth S of rainfall event 1. This conclusion allows us to apply for a permanent rainwater storage solution and water rain occurs in the storm.

The application of SCS - CN method combined with GIS is also implemented for 14 sub-basins of Co To Island. The results of the distribution of hydrological parameters on sub-basins with permeability conditions, topography, land use area and different soil quality have shown the reasonableness of the general hydrological law.

In this study, we performed the calculation of Q_0 value and this value was verified by monitoring data in September and October 2012. Thus, the Q_0 value was determined by the average of the set of the 30-year precipitation over the Big Co To island is 0.39 m^3/s, which can be used as a reference for other models such as SWAT as well as for designing rainwater storage techniques on the island.

The calculation results of this study once again confirm the superiority of traditional SCS - CN method when combined with GIS will be a main tool to estimate hydrological parameters on the island.

ACKNOWLEDGEMENT

This study belongs to the topic KC 09 04/16 20 funded by the Ministry of Science and Technology of Vietnam. This financial support is gratefully acknowledged. The Project code: KC 09 04/16 – 20 namely “Estimation of potential and variation of surface, underground water resources and proposed appropriate measures for water resource management to support economical – social development on some important islands”.

CONFLICTS OF INTEREST

The authors declare no conflict of interest. The founding sponsor had no role in the design of the study, in the collection, analyzing, or interpretation of data, in the writing of the manuscript and in the decision to publish the results.

https://dx.doi.org/10.22161/ijaers.69.6 *ISSN: 2349-6495(P) | 2456-1908(O)*

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https://dx.doi.org/10.22161/ijaers.69.7 ISSN: 2349-6495(P) | 2456-1908(O)

The Determination of the Brick Basic Price at Toba Trading Company

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Abstract**—***The reasearh aims to know the calculation of the cost production Brick Basic at Toba Trading Company, to compare the cost of production of Brick Basic established by UD. Toba by determining the cost of production based on a theoretical approach full costing method. The difference between the cost of production of Brick basic per unit assigned UD. Toba in compared by the authorin 2018 are 1) Direct Production Costs per brick produced:Cost of using raw materials: IDR. 40,51/piece + Direct labor wage: IDR. 63.90, / piece, The Total Direct Production Costs: IDR 104.41, /Piece. 2) The Indirect Production Costs per piece of Bricks produced: Usage Costs for Indirect Materials: IDR. 40,51 / piece + Indirect wages: IDR. 21.19, - / piece + Other Indirect Production Costs: IDR. 19.99, - / piece, The Total Indirect Production Costs: IDR. 81.69, - / piece. Based on the results of the analysis can be seen that the calculation of the cost of production of that has been established by UD . Toba is greater than the cost of Brick Basic production calculation based on a full costing method of cost accounting theory approach. The difference cal culation cost of production Brick Basic between theory and companies due to differences in acknowledging the large amount of raw material costs and the large number of factory overhead costs both fixed and variable.*

Keywords**—Determination, bricks' basic price.**

I. INTRODUCTION

The key goal of most business entities or companies is to obtain the prices that can contribute as much as possible to be profit. This is what economists call profit maximization. Earnings per unit are not as important as realized profits from all units sold. Therefore, the price that will generate the greatest profit for a certain sales volume must be charged to the consumer. The determination of cost of goods is a complex problem and is not the task of one person or one activity. Theorists and practitioners disagree for a variety of pricing theories, therefore research works that require collaboration and coordination between economists, statisticians, marketing specialists, industrial engineers and accountants to decide. Because setting the selling price requires consideration of many factors, some of which may not be measured, or controlled, a wise judgment is needed from the practitioner. The Accountants can help executive management and marketing managers with benchmarks that can be used as guidelines in exploring relatively uncharted paths to successful pricing. The Cost is generally seen as a starting point in the business of pricing, although the relationship between the two should not be seen rigidly. The pricing policies change in relation to costs and market situation, and also with long-term and short-term views. The long-term approach allows changes in product types, production methods, factory capacity, marketing and the distribution methods. It is intended for prices that can recover all costs plus a reasonable return on invested capital. The Normal or average production costs are the basis used for pricing in the short term aimed at covering / replacing at least a portion of the total costs in order to meet changing needs as a result of fluctuations in sales volume, a combination of sales and prices in such circumstances Product diffraction costs can act as a guideline for pricing. The relationship between costs and prices is one of the most difficult problems for managers to determine. Pricing is an area where management really is an art. Selling prices, which are generally seen as the level of exchange between two types of commodities in many industries, are determined in such a way as to allow certain controls over these prices. Even companies that face intense competition can still control the selling prices because there may be differences in the types of production, quality and services provided. . However, if compared with controlling the costs incurred, the company's ability to control selling prices is certainly much smaller.

II. REVIEW OF LITERATURE

The amount of money spent by producers to pay for inputs or factors of production used in the production process of output is called the amount of production costs. The size depends on the amount of input and the high and low prices of the inputs used. The amount and price of inputs depends on how much the output (goods / services) produced by producers can therefore be stated that the amount of production costs is influenced by the amount of output. Mathematically it can be seen that the total cost is a function of the amount of output or:

TC = F (Q)
TC = Total cost
F = Function
Q = Number of outputs

https://dx.doi.org/10.22161/ijaers.69.7 ISSN: 2349-6495(P) | 2456-1908(O)

In a broad sense, the cost is the sacrifice of an economic resource that is measured in units of money that have occurred or might occur to achieve a certain goal. The economic source itself can be divided into two parts, namely the sacrifice that has occurred, for example for capital loan interest that must be paid months later.

In order to avoid chaos in managing funds or costs, an entrepreneur must be able to distinguish expenses that do not include costs. Before learning about production costs, production costs can be reviewed in advance the types of production costs from various aspects, among others:

1. Costs based on its characteristics

The types of costs seen from their nature can be divided into two namely costs:

- General
- Specific

Special Costs are the direct costs having a relationship with certain parts of the product. Special fees have been directed towards certain costs, for example:

- Cost of Raw Materials
- Labor costs
- Machine Costs

General costs are costs that have not been stated in a special fee consisting of various costs, each of which costs are relatively small so that they are combined into general costs, for example:

- Correspondence Fee
- Telephone Charges
- Stationery

2. Costs Based on Relationship with the Goods or Services Produced.

Classification of costs based on the relationship of goods or services produced is called classification of costs according to causal or causal relations. Classification of costs according to a causal relationship can be divided into costs:

- Direct
- Indirect

Direct costs are costs that have occurred since they have a causal relationship with the unity of production. Direct costs occur because there is paid, which is something that will be produced. If there is no production, then there is no direct cost. For example; the direct cost of the Toba Trading Company is the labor cost.

Indirect costs are those which are indirectly charged to production for example: The indirect costs of the Toba Trading Company are electricity, depreciation of factories and machinery.

3. Costs According to Relationship with the Bookkeeping Period

The Consideration of carrying out a classification of costs to be associated with the accounting period because not all costs incurred can be used up charged to a production during the same accounting period.

4. Costs Based on Basic Functions in the Company

The main functions in manufacturing companies are production, administration and general functions as well as marketing functions. In companies there are often parts of the company that are the same as the main function. Therefore according to basic functions, costs can be divided into:

- Production cost
- Administration and general fee
- Marketing costs

Production costs are the cost of raw materials, labor costs, and factory overhead labor costs, and factory overhead costs. The factory overhead costs are indirect costs. Raw material costs and labor costs are also called prime costs. Factory overhead costs are called conversion costs

Administrative and General Costs are costs that cannot be identified with production or marketing activities but, are related to these activities for example:

- Administrative costs
- Administration Section Fee
- Personnel Section

III. RESEARCH METHODOLOGY

To solve a problem, data is needed in accordance with the problem being discussed, both primary data and secondary data. Primary data is data obtained directly from the object of research, while secondary data is data obtained from other parties that are not collected by themselves, such as monthly reports / data on a company or agency in accordance with the disciplines occupied and the title of thesis or report and so forth

In this chapter the authors state or attach the results of direct observations and measurements as well as recording company data from Toba Trading Company related to the problem, then the data obtained was processed for the use in problem solving.

Method of collecting data

The Steps in collecting the data:

1) Recording the required data from the company.
2) Observing and recording everything related to the object of the research.
3) Conducting interviews with parties related to the problem discussed and recording the results of the interview.

Data collected

Data collected and used to solve the problems in this study are:

1. The Direct Production Costs

The Cost of using direct raw materials is the use of all types of raw materials and other parts that can be calculated directly. The raw materials used are “Galong” soil and “Cabuk” soil.

2. The Direct labor wages, namely wages paid at the factory for each type of goods and can be calculated directly into the basic price of each type of goods.

3. The Indirect Production Costs

https://dx.doi.org/10.22161/ijaers.69.7 *ISSN: 2349-6495(P) | 2456-1908(O)*

a. The cost of using indirect raw materials is the cost of materials that participate in the production process but does not form part of the production of direct raw materials consisting of:
- Sand usage fee
- Wood usage fee
- Solar fuel usage costs
- Lubrication oil usage costs

b. Indirect wages are labor costs that do not directly participate in the production processing such as;
- Chairman's wages
- Secretary's wages
- Personnel wages
- Engineering Staff wages
- Processing Employee Wages

c. Other indirect production costs are costs that are not included in raw materials and indirect labor costs. Other indirect production costs are:
- Electricity and water costs for offices and factories
- Insurance fee
- Maintenance and repair costs
- Permit fees, PBB and vehicle tax
- Administrative costs
- Depression costs

d. The Quantity Data on Brick Production

The data of Bricks produced by Toba Trading Company was during January 2018 to December 2018.

IV. FINDING AND DISCUSSION

After processing the data, then the price of each cost element is obtained for each month. These cost elements have variations in prices for each month, so it needs to be controlled to get the prices received, then the determination of production costs to get the cost of production per piece of brick produced, can be completed as follows:

1. Direct Production Costs per brick produced:
   - Cost of using raw materials: IDR. 40,51/piece + Direct labor wage: IDR. 63.90, / piece
   - The Total Direct Production Costs: IDR 104.41, /Piece
2. The Indirect Production Costs per piece of Bricks produced:
   - Usage Costs for Indirect Materials: IDR. 40,51 / piece + Indirect wages: IDR. 21.19, - / piece + Other Indirect Production Costs: IDR. 19.99, - / piece
   - The Total Indirect Production Costs: IDR. 81.69, - / piece
3. Forecasting or Estimation

a. Zero Free Method

From the data of production capacity in table 3.1, it can be drawn a trend line of production capacity and an estimated production capacity in January.

- Known Equation: Y '= a + b. x
  I. $\sum y = n.a + b.\sum x$
  II. $\sum xy = a.\sum x + b.\sum x^2$
- Trend equation: Y '= a + b. x
  I. $\sum y = n.a + b.\sum x$ ……7.660.000 = 12.a – 6.b
  II. $\sum xy = a.\sum x + b.\sum x^2$ …… 3.805 = - 6.a + 146.b
  - From Equations I and II:
    7.660.000 = 12.a – 6.b :1 :7.660.000 = 12.a – 6.b
    - 3.805.000 = -6.a + 146.b:2: - 7.610.000 = - 12.a + 292.b +
    50.000 = 286.b
    b = 174,825
  - From equation I
    7,660,000 = 12.a - 6.b
    = 12.a - 6 (174,825)
    = 12.a - 1048,951
    a = 87,412
    So Y ' = 87,412 + 1048,951. x
    For x = 6
    then:
    Y ' = 87,412 + 1,048,951. 6
    = 87,412 + 6,293,706
    = 6,381
  - Calculation of Trend prices with the Zero Free Method are:

Calculation of Trend prices with the Zero Free Method are:
- January: Y '= 638,333,333 + 87,412 (-6) = 639,295
- February: Y '= 638,333,333 + 87,412 (-5) = 637,547
- March: Y '= 638,333,333 + 87,412 (-4) = 638,945
- April: Y '= 638,333,333 + 87,412 (-3) = 638,770
- May: Y '= 638,333,333 + 87,412 (-2) = 638,596
- June: Y '= 638,333,333 + 87,412 (-1) = 638,246
- July: Y '= 638,333,333 + 87,412 (0) = 638,421
- August: Y '= 638,333,333 + 87,412 (1) = 638,596
- September: Y '= 638,333,333 + 87,412 (2) = 638,770
- October: Y '= 638,333,333 + 87,412 (3) = 638,945
- November: Y '= 638,333,333 + 87,412 (4) = 639,120
- December: Y '= 638,333,333 + 87,412 (5) = 639,295

The Calculation of Brick Capacity Trend With the Zero Free Linear Trend Method January-December 2018 (in piece)

Month	Production Capacity	X	X .Y	X^2
January	590,000	-6	- 328.692	36
February	620,000	-5	-582.440	25
March	700,000	-4	-433.956	16
April	680,000	-3	-223.653	9
May	600,000	-2	-104.724	4

https://dx.doi.org/10.22161/ijaers.69.7 *ISSN: 2349-6495(P) | 2456-1908(O)*

June	660,000	-1	-73.883	1
July	585,000	0	0	0
August	625,000	1	86.596	1
September	700,000	2	188.034	4
October	670,000	3	337.503	9
November	650,000	4	491.160	16
December	580,000	5	690.470	25
Total	**7,660,000**	**-6**	**46.415**	**146**

The Midpoint Method as a Base Month

In the Midpoint Method As this Base Month, the sum of the values on the X scale must be zero so that the values of a and b can be determined by using the following formulation:

$$a = \frac{\Sigma Y}{n}$$

$$b = \frac{\Sigma XY}{X^2}$$

n = amount of data.

By continuing to use the data shown in table 3-1, the line equation and capacity for 2008, January, can be calculated as follows:

$$a = \frac{7.660.000}{12}$$

$$a = 638.333{,}33$$

$$b = \frac{50.000}{572}$$

$$b = 87{,}412$$

Y' = 638.333,333 + 87,412 . **x**

x = 13,

Y' = 638.333,333 + 87,412 (13)

= 638.333,333 + 1.136,363

= 639.469

So the January 2008 production capacity was 639,469 units

Whereas the calculation of trend prices for all available months is as follows:

- January: Y '= 638,333,333 + 87,412 (-11) = 639,295
- February: Y '= 638,333,333 + 87,412 (-9) = 637,547
- March: Y '= 638,333,333 + 87,412 (-7) = 638,945
- April: Y '= 638,333,333 + 87,412 (-5) = 638,770
- May: Y '= 638,333,333 + 87,412 (-3) = 638,596
- June: Y '= 638,333,333 + 87,412 (-1) = 638,246
- July: Y '= 638,333,333 + 87,412 (1) = 638,421
- August: Y '= 638,333,333 + 87,412 (3) = 638,596
- September: Y '= 638,333,333 + 87,412 (5) = 638,770
- October: Y '= 638,333,333 + 87,412 (7) = 638,945
- November: Y '= 638,333,333 + 87,412 (9) = 639,120
- December: Y '= 638,333,333 + 87,412 (11) = 639,295

Month	Production Capacity (y)	X	X.Y	X^2
January	54.782	-11	-602.602	121
Febrauary	116.489	-9	-1.048.401	81
March	108.489	-7	-759.423	49
April	74.551	-5	-372.755	25
May	52.362	-3	-157.086	9
June	58.569	-1	-58.569	1
July	73.883	1	-73.883	1
August	86.597	3	-259.791	9
September	94.017	5	-470.085	25
October	112.501	7	-787.507	49
November	122.790	9	-1.105.110	81
December	138.094	11	-1.519.034	121
Total	1.093.124	0	1.216.574	572

Trend Calculation With The Midpoint Method as A Base Month During January – December (In piece)

V. CONCLUSION

Many problems in the company can only be solved by problems if we have enough knowledge about the costs associated with them. Therefore the calculation of cost of goods is an important instrument for corporate control. We immediately felt when the company was about to be founded. When we set up we will provide benefits in terms of the costs that must be made and the sales results that will be obtained, if it is profitable, what products are calculated to provide the most profit.

The main objectives of calculating cost of goods:

a. To obtain data and information needed to make optimal short-term planning in the area of sales and production.
b. To obtain data and information to control the production process, especially with a view to obtaining savings within the company.

By paying attention to the constraints in setting the cost of goods in a company, a very big obstacle is the ups and downs of production capacity. The production capacity is not normal month by month and it is seen that the cost of goods also fluctuates with the ups and downs of the company's production capacity. Because according to the formula:

Cost of goods per unit = total production costs / Production capacity

It is clear how dependence of cost of goods on production capacity. With changes in production capacity, the cost of goods will change directly.

https://dx.doi.org/10.22161/ijaers.69.7 *ISSN: 2349-6495(P) | 2456-1908(O)*

The value of money from the means of production sacrificed in the production process is called cost of goods with three purposes for calculating cost of goods, three basic calculation functions are found:

a) The basis for determining or assessing the selling price
b) The Efficiency control tools
c) The foundation of the balance sheet and goods in progress and finished goods.

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https://dx.doi.org/10.22161/ijaers.69.8 ISSN: 2349-6495(P) | 2456-1908(O)

The Effect of the Science and Technology Development on the Students' Learning Achievement of Grade XI Students at SMK Teladan Pematangsiantar

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Abstract *—This study aims to determine the influence of the development of science and technology on the students' achievement of grade XI at SMK TELADAN Pematangsiantar. This research was conducted at SMK TELADAN Pematangsiantar, the population is all the students of class XI as many as 83 students. The instrument used to measure the variable X was in the form of a questionnaire, while to measure the variable Y, it was seen from the school documentation in the form of a list of scores in odd semester. The Data analysis techniques used to determine the relationship between variable X and variable Y are Product Moment Correlations. From these calculations, the results obtained r count = 0.618 means the influence of the development of science and technology (variable X) on student achievement (variable Y) is categorized as strong. To test the hypothesis the t-test is used. From the calculations, it was obtained; t-count 7.07 which is then compared with t-table at the significant level of 95% or alpha 5% and degrees of freedom (df = n - 2, 83 - 2 = 81) with a value of t-count> t-table or 7.07> 1.67 Thus the hypothesis is accepted, namely: There is a significant effect between the development of science and technology on students' learning achievement of class XI at SMK Teladan Pematangsiantar.*

Keywords *— science and technology development, students' achievement.*

I. INTRODUCTION

In this modern era, the technological revolution looks very striking in two ways, namely the field of information and communication. Both of them experienced an escalation of transformation so powerful that it might never have been imagined before. Both of them have penetrated so deep down to the smallest realms of human life, without any other force capable of blocking it. This is all driven by the determination of global power which is extremely powerful and at this critical point, the world of education must be able to respond dynamically, creatively, and productively.

We live in an age of information openness and freedom of communication. This is an era in which information can be accessed by anyone, at any time, and without limits, from and all over the world. In this critical era, educational institutions cannot just close themselves off from developments in the outside world.

In fact, educational institutions must be proactive in developing aspects of information and communication technology, so that ICT can be used to support the effectiveness of the current education program.

"The application of information and communication technology to education is a real and factual challenge. This big role is the responsibility of the world of education" A. Malik Fadjar (1999: 157), theoretically and empirically, education is recognized as an institutional force for a nation in achieving progress. Moreover, in the era of globalization which is full of economic competition, civilization, and technology as it is today, there is no other way for us except to appear as dynamists and creators, in driving progress and enlightenment on all elements of the nation through the world of education. Teachers are required not only to utilize existing learning resources at school (let alone only read textbooks), but are also required to study various learning resources, such as magazines, newspapers and the internet.

This is important, so that what is learned is in accordance with the conditions and development of the community, so that there are no gaps in the mindset of students.

It also needs to be done in order to strengthen the goals of national education in the midst of international competition. The purpose of national education is to develop the potential of participants educate them to become people who have faith and are devoted to God Almighty, have good character, are healthy, knowledgeable, competent, creative, independent, and become citizens who are democratic and responsible for society and nationality.

This is what drives the desire of the writer to conduct a research at the Vocational High School (SMK) in order to get a definite picture of the influence of the development of science and technology on the learning achievement of class XI students at Pematangsiantar. This is reflected in how to increase knowledge in improving student learning achievement itself.

https://dx.doi.org/10.22161/ijaers.69.8 ISSN: 2349-6495(P) | 2456-1908(O)

With the success of this research, a profile of the world of education can be obtained which is able to adopt the advantages and advantages of the technology for the future of students.

Formulation of the problem

Based on the background of the problem and the limitations of the problem, the researcher formulated the research problem as follows:

"Is there a significant effect of the development of science and technology on students' achievement of grade XI at SMK Teladan Pematangsiantar? ".

II. REVIEW OF LITERATURE

The Importance of Information Technology in Learning According to Dr. Munir (2007: 50), in the current ICT era, the learning paradigm has shifted from traditional learning to technology-based learning. Learning is now not only using the blackboard. The instructor also not only lectures in front of the class while writing on the board, while students just sit, listen, and take notes. Various media resulting from technology including television, VCD, DVD, and computer become an important requirement in learning because of its ability.

Skills in utilizing ICT are life skills that must be possessed by students. These skills are as important as the ability to read, write, count, formulate and solve problems, manage resources, and work in groups. Students who do not have skills in ICTs are expected to experience greater difficulties in dealing with their lives in the present and the future.

The focus of attention on the development of ICT which is usually only on the purchase of sophisticated software / hardware in accordance with the trend and costly funds, has shifted to optimizing the ability of human resources (brainware) of ICT users, such as computer literacy.

The students are able to use computers optimally, know where to get them, understand how to package or process information, and understand how to communicate it.

This century is an era of the development of science and technology. These developments have a major impact on people's lives, because basically almost all aspects of modern people's lives cannot be separated from knowledge and technology. The community is demanded to be actively involved in the technological process that will play a role in the life of the present and the future. Communities that are active in the technological process will be able to choose, design, make and use the results of the engineering technology. Part of the community is a school in which there are students.

The students learn to design and make their own technological works. In addition, they are trained to find and solve problems in their daily lives that can be solved by utilizing technology.

ICT-based learning will be effective if we apply learning that is centered on student activities (student / learned centered learning), namely by:

1. Develop students' ability to solve problems in real life (contextual), so that education becomes relevant and responsive to the demands of everyday real life. The implication, the curriculum becomes more interesting and can stimulate the interests or motivation of students, because it can easily apply their knowledge in real life everyday.
2. Cultivating reflective thinking; and
3. Assist the development and active involvement of students in the learning process.

III. RESEARCH METHODOLOGY

The method used in this study was an experimental method with the intention to see the Effect of the development of science and technology on students' achievement of grade class XI SMK Teladan Pematangsiantar in academic year 2017/2018, then the research location is: at SMK Teladan Pematangsiantar located on the Singosari street No. 3. The reasons for choosing the location include:

1. The location of the school is easily accessible by transportation from the author's home or from the Pematangsiantar FKIP campus so as to save time and money used.
2. The schools meet the requirements to become objects of research because the data needed by researchers is available at the school.
3. The availability of the schools to accept researcher in conducting a research to collect data in this study.
4. The school has a well-accredited value regarding the development of science and technology so that researcher is interested in conducting research.

IV. THE FINDING AND DISCUSSION

To find out the influence of the development of science and technology (X) on the students' achievement (Y) of grade XI at SMK TELADAN Pematangsiantar in academic year 2017/2018, it was carried out using a simple linear regression formula, and the value obtained from the calculations is the in Appendix 9 (page 112) are as follows:

N = 83 $\sum Y = 6826$

$\sum X = 5543$ $\sum Y^2 = 565.020$

$\sum X^2 = 1.069.815$ $(\sum X)^2 = 46.594.276$

$(\sum X)^2 = 30.724.849$ $\sum XY = 454.602$

then:

$Y = a + bx$

$$a = \frac{N\sum Xy - (\sum X)(\sum XY)}{N\sum X^2 - (\sum X)^2}$$

$$a = \frac{(6826)(1.069.815) - (5543)(454.602)}{83(1.069.815) - (5543)^2}$$

$$a = \frac{7.302.557.190 - 2.519.858.886}{88.794.645 - 30.724.849}$$

https://dx.doi.org/10.22161/ijaers.69.8 *ISSN: 2349-6495(P) | 2456-1908(O)*

$a = \frac{4.782.698.304}{58.069.796}$

a = 82,36

$b = \frac{N\sum XY-(\sum X)(\sum XY)}{N\sum X^2-(\sum X)^2}$

$b = \frac{83(454.602)-(5543)(454.602)}{83(1.069.815)-(5543)^2}$

$b = \frac{37.731.966-2.519.858.886}{88.794.645-30.724.849}$

$b = \frac{2.482.126.920}{58.069.796}$

b = 42,74

Thus the simple linear regression equation about the development of science and technology (X) on student achievement (Y) of grade XI SMK Teladan Pematangsiantar is described as follows: Y = 82.36 + 42.74x

This means that if the development of science and technology (X) has a score of 77 then Y = 82.36 + 42.27 (77) = 3373 or in other words if the development of science and technology has a score of 42.27 then it can be estimated that the students' learning achievement score (Y) is 33.73%.

To determine the degree of relationship between the development of science and technology (X) with student learning achievement (Y) then calculated using the simple correlation test formula as follows:

$r = \frac{N(\sum XY)-(\sum X)(\sum Y)\}}{N(\sum X^2)(\sum Y)^2}$

$= \frac{(83(454.602)-(5543)(6826)\}}{83(1.069.815)(565.020)}$

$= \frac{3.102.709.028}{5.017.075.130}$

r = 0,618

Based on the calculation above, the r value = 0.618 is obtained so that the influence of the variable X (science and technology development) with the Y variable (students' learning achievement) is categorized as strong, because it is in the interpretation criteria 0,600 - 0,790 Then the magnitude of the correlation coefficient of 0.618 or categorized as strong.

Hypothesis Testing

To test the hypothesis that has been proposed previously The formula:

$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$

$t = \frac{0,618\sqrt{83-2}}{\sqrt{1-(0,618)^2}}$

$t = \frac{0,618\sqrt{81}}{\sqrt{1-0,381924}}$

$t = \frac{5,56}{\sqrt{0,618076}}$

$t = \frac{5,56}{0,7862}$

t =7,07

To accept or reject a hypothesis that has been submitted, it was calculated by t-test analysis. The magnitude of t-count is 7.07 while the t-table is at a significant level of 95% or alpha 5% and the degree of freedom (df = n-2, 83-2 = 81), because it is not in the table t, then it looked for by using the interpolation formula:

$\frac{a}{b} = \frac{c}{d}$

$\frac{81-60}{120-60} = \frac{x-1,67}{1,66-1,67}$

$\frac{21}{60} = \frac{x-1,67}{0,01}$

0,21 = 60x - 100,2

$x = \frac{100,41}{60}$

x = 1,67

Because t-count> t-table or 7.07> 1.67, thus the research hypothesis "There is a significant effect between the development of science and technology on the students' learning achievement of class XI students of SMK TELADAN Pematangsiantar" was accepted.

This study refers to the hypothesis which states that there is a significant influence between the development of science and technology with the achievement of class XI students of SMK TELADAN Pematangsiantar in Academic Year 2017/2018.

In accordance with the calculations that have been done, namely by calculating the influence of X and Y obtained an effect of 0.618 so that this shows a very strong influence between the development of science and technology with student achievement. Then the correlation results are tested by using the t-test hypothesis, the results of calculations show that t = 7.07 while t-table at a significant level of 95% and alpha 5% with Df (83-2) = (1.67).

This shows that t-count> t table or 7.07> 1.67. Means the hypothesis stated that there is a significant influence between the development of science and technology with students' achievement of grade XI at SMK TELADAN Pematangsiantar in academic year 2017/2018, is accepted.

The development of science and technology in SMK TELADAN Pematangsiantar, when viewed from the calculations that have been made are classified in the strong category. This should be further improved because it will be very useful in the future. Because the development of science and technology is a progress in increasing knowledge. Therefore we use science and technology development as well as possible and we use it to positive things.

V. CONCLUSION

Based on the results of data analysis conducted by researcher, the following conclusions are obtained:

1. The Development of Science and Technology for students in class XI is "enough". This can be seen from the average value of respondents' answers to the science and technology development questionnaire that is equal to 2.25.
2. From the research results obtained an average learning achievement of 82.24. This shows that the learning achievement of Grade XI students in odd semester was categorized high according to the calculation table of the distribution of student achievement.
3. From the results of the calculation of the product moment correlation coefficient, it's obtained r-

https://dx.doi.org/10.22161/ijaers.69.8 *ISSN: 2349-6495(P) | 2456-1908(O)*

count= 0.618. This shows that the influence of the development of science and technology on student achievement is categorized as strong because it is in the criteria of interpretation 0,600 - 0,790, according to the interpretation table value of r.

4. From the results of t-test calculations, to determine the contribution of the influence of science and technology development (X) with learning achievement (Y) obtained by 7.07 and t-table of 1.67 at degrees of freedom dk = n - 2, where t-count <t-table or 7.07 > 1.67.

This shows that the hypothesis stated that there is a significant effect between the development of science and technology on students' achievement of grade XI at SMK Teladan Pematangsiantar is accepted.

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https://dx.doi.org/10.22161/ijaers.69.9 ISSN: 2349-6495(P) | 2456-1908(O)

Application of AHP for Fuel transportation Environmental impact Assessment in submerged Pipelines

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Abstract*— *This study presents an evaluation of associated impacts by leaks in fuel pipelines transportation. Often, the pipelines are built in public and private properties into rural and urban areas. The potential environmental impacts were evaluated using the Analytic Hierarchy Process (AHP). The study was applied for the Billings dam case, located in Brazil. The Expert Choice® software was used as a tool to implement AHP methodology. The evaluated fuels were: oil, natural gas and alcohol-based fuel. Fire, environmental contamination and toxicity were the main evaluation criteria associated with leak impacts. Oil presented the highest associated impact, followed by alcohol-based fuel and natural gas.

***Keywords*— AHP; environmental impacts; fuels; pipeline.**

I. INTRODUCTION

Among the industries of pipeline transportation, the oil industry is the main benefit; it has vast territorial extensions of installation systems, according to data provided by the security cabinet of the US agency, the National Transportation Safety Board (NTSB, 2002).

The hydrocarbons transport, mainly natural gas, oil and oil products have generated technical challenges, to minimize fuel leaks and environmental impacts due to pipelines issues. Constantly, the oil industry deals with problems resulting by leaks, spills and accidents during stages of exploration, refining, transport and oil (derived products) storage (SANTANA, 2004). In the Brazilian case, studies about impacts mapping of accidents in ducts have been conducted, aiming the use of land. However, there are not literature focusing on the pricing of land uses for later applications, therefore there is a lack of information about pricing issues and their relation with impacts on Billings areas due to pipelines passage (ANP, 2015).

The Billings dam incorporates a system of hydraulic power generation, Henry Borden is a concession area granted to Metropolitan Company of Water and Energy (EMAE). Especially, this area is highly potential demand territory for fuels transport studies, due to the geostrategic location between distribution and reception points of fuels. The easement area of Henry Borden power plant was identified as a protected space through environmental licenses and additional legal requirements. Then, any commercial and industrial activities must be associated with these strict statements. In recent years, the largest oil reservoir was discovered and it was named Pre-salt due to geological location in Brazilian states of Santos (SP) to Plano Alto. Then, a rise of oil production and refining in Brazil are expected, to meet the proposed energetic demands and economic policies with the actual governing. This latter situation has been part of speculation by different sectors of environmental protectionist, that the easement area of Henry Borden is a target of the oil and energy industry (CAPOBIANCO, 2002).

Despite pipeline transportation is considered a safe and reliable way for transporting dangerous and flammable substances, such as oil and gas, there are several factors during the transportation process such as third-party damage, corrosion destruction, design flaws, misuse, among others that could cause leakage and consequently affect social security and environment (GUO et al., 2016).

https://dx.doi.org/10.22161/ijaers.69.9 ISSN: 2349-6495(P) | 2456-1908(O)

The fuel transport through pipeline includes a high risk of impact due to failure in the pipeline and subsequent leakage, for both the population and the environmental impacts. Events that take place in population and involved areas after a fuel leak are the assumed impacts of this study.

Analytic Hierarchy Process (AHP) is normally used as a multi-criteria decision-making method and widely used for a sustainable development decision. It was used for instance by De la Fuente et al. (2016) to set weights for a sustainability assessment of sewerage pipe systems, by Dey (2002) in a project feasibility analysis related to oil pipeline in India, by Suganthi (2018) where through AHP method it was possible to set sustainability criteria for a more sustainable development decision, by Guo et al. (2016) in a risk evaluation of long-distance oil and gas transportation pipelines with the intent to minimize leakage or rupture risks of pipelines.

In the event of fuel shedding, the major concern is the possibility of fire with problems of toxicity and pollution on aquifers, for occupied or unoccupied areas. The Billings dam has conservation areas with environmental importance. Then, an evaluation method should be necessary to apply, and so quantifying possible impacts associated with leaks and kind of fuel.

Industrial installations have different piping arrangements and it is considered an efficient way of transport substances, however, it has raised some major concerns in terms of safety, due to frequent accidental gas explosions that caused serious damage, motivated risk assessment of flame propagation and explosion of pipeline fuel transportation (EMAMI et al., 2016)

The importance is mainly focused on the relevance that these areas have because those are part of an energy Hydro-complex (Henry Borden), which in addition to generated energy, supplies water to Metropolitan region of São Paulo (RMSP). The evaluation of consequences through the sensitivity of the areas thus generate greater acceptance by the population both in Brazil and in the world, the potential impacts and mitigating them later, in case of a leakage accident occur on the easement area of the ducts.

Citizen perceptions or beliefs about the benefits and risks of a project, such as fuel transport pipeline or offshore oil drilling, are typically important predictors of acceptance or opposition. Citizen acceptance can be associated with perceptions of economic benefits and opposition can be associated with perceptions of local environmental risks, such as the Exxon-Valdez oil spill in 1989 (AXSEN, 2014).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. METHODOLOGY

In the evaluation case of the generated impact is necessary to consider each involved fuel, physical and chemical properties associated with fire probability, pollution and toxicity of selected fuels. The classification considerations of consequences based on a review of environmental and social studies, determining caused impacts by fuel spills events.

The AHP method is one of the first developed methods in the area of discrete multi-criteria decisions, created by Professor Thomas Saaty (1980). In this method the decision problem is divided into hierarchical levels, easing its understanding and evaluation. According to Costa (2002), this method is based on the three-step of analytical thinking:

Hierarchies Construction: For the application of this methodology it is necessary that criteria and alternatives can be structured hierarchically.

Defining priorities: This principle is needed to judge pairwise elements of a hierarchy level associated to an upper level, a matrix of judgment comparison is made between the elements using the basic scale of Saaty ranking (from 1 to 9).

Logic consistency: The decision-maker can establish relationships between objects or ideas. Consistency is presented if they are consistent, such that they relate to each other and their relations show consistency.

There are influencing variables that directly impact identification, which are: leak area, leakage time until being interrupted, and fuel type. It was used an input orientation that seeks to minimize input values for the same production of output, avoiding the problem to have a large number of Decision Making Units, according to Silva et al. (2019). Finally, the criteria for the evaluation of potential impacts were identified.

- Fire;
- Toxicity;
- Environmental contamination.

The fuels associated with impacts are analyzed by their physicochemical properties related to each fuel (oil, alcohol and gas natural), as the main objective to determine the potential associated environmental damage.

The choice of physicochemical properties was done per event or result.

For fire, the properties are inflammability, vapor pressure, solubility and concentration (flammability limits) are shown in Figure 1. If a substance is flammable, it

https://dx.doi.org/10.22161/ijaers.69.9 ISSN: 2349-6495(P) | 2456-1908(O)

generates risk and hazard of conflagration if it has a higher vapor pressure, it will generate a fire hazard in comparison to other compounds with lower vapor pressure. If it is not soluble, the substance will remain on the surface, which creates a fire hazard. If these three properties are presented in the same substance, it will be more likely to have the risk of fire and conflagration. In the case of a substance having two or one of the properties presented above, the fire threat will be lower, depending on the importance of the associated property for the development of a fire.

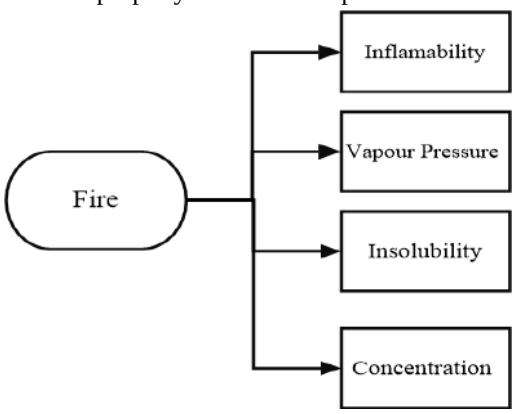

Fig. 1: Physicochemical properties of fuels associated with fire

For toxicity, the properties are: Eco toxicity, mobility in soil, human toxicity, degradability and solubility shown in Figure 2. The above properties illustrate that if a substance has high mobility in soil and is a toxic substance if it is spilled will pollute and contaminate as well. Regarding the existence of deposits of groundwater, this will increase environmental impacts. The degradability as a chosen property represents the time of life of this substance, can be degradable or biodegradable, according to the established parameters, as mitigation the impact generated on the areas will be lower.

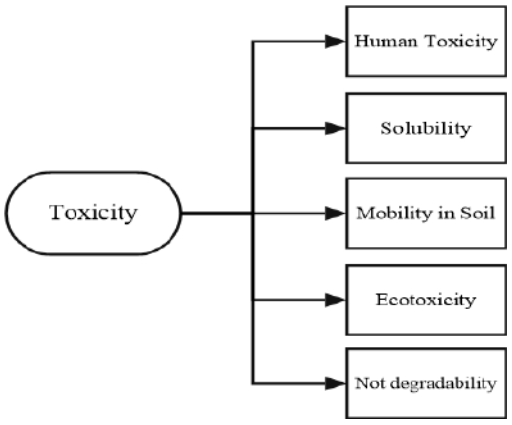

Fig. 2: Physicochemical properties of fuels associated with toxicity

For environmental contamination, the properties are density, degradability, solubility and mobility in soil shown in Figure 3. In this case, the physical properties represent better the potential damage on these ecosystems. A substance that is soluble in water, which has high mobility in soil, low density and low degradability, it is the substance that can cause higher damage on the ecosystem due to the difficulty to remove it from these areas. Presence and permanence in water and land will be higher compared to other substances.

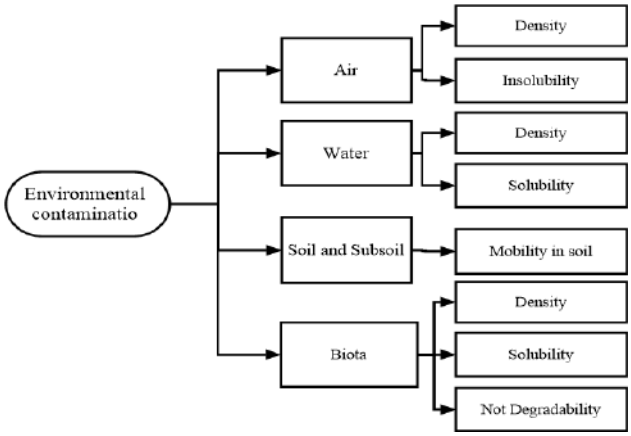

Fig. 3: Physicochemical properties of fuels associated to environmental contamination

2.1 Construction of hierarchies

The existence of a decision hierarchy is the main point of AHP, for the application of this methodology, it is necessary that criteria and alternative can be structured hierarchically. The first level corresponds to the general purpose of the issue, the second and third levels are the criteria and the alternatives.

The complete impact assessment represents the hierarchy for leadership levels of criteria, identified and defined by impacts of fuel spillage on the easement areas.

The hierarchy spreadsheet was constructed on four levels, considering the variables in the problem analysis, as shown in Figure 4 according to Saaty (1991).

Level 1: In this level, is located the goal of the evaluation (Fuel with highest associated impact);

Level 2: This refers, primarily to defined criteria to the evaluation of fuel with highest associated impact as a fire, toxicity and environmental contaminations;

Level 3: In this level, takes place the detailing sub criteria of the previous level (Figure 1, 2 and 3);

Level 4: This level is the lowest in the hierarchical spreadsheet decision and shows the goal fuels (oil, ethanol and gas) in this study.

https://dx.doi.org/10.22161/ijaers.69.9 *ISSN: 2349-6495(P) | 2456-1908(O)*

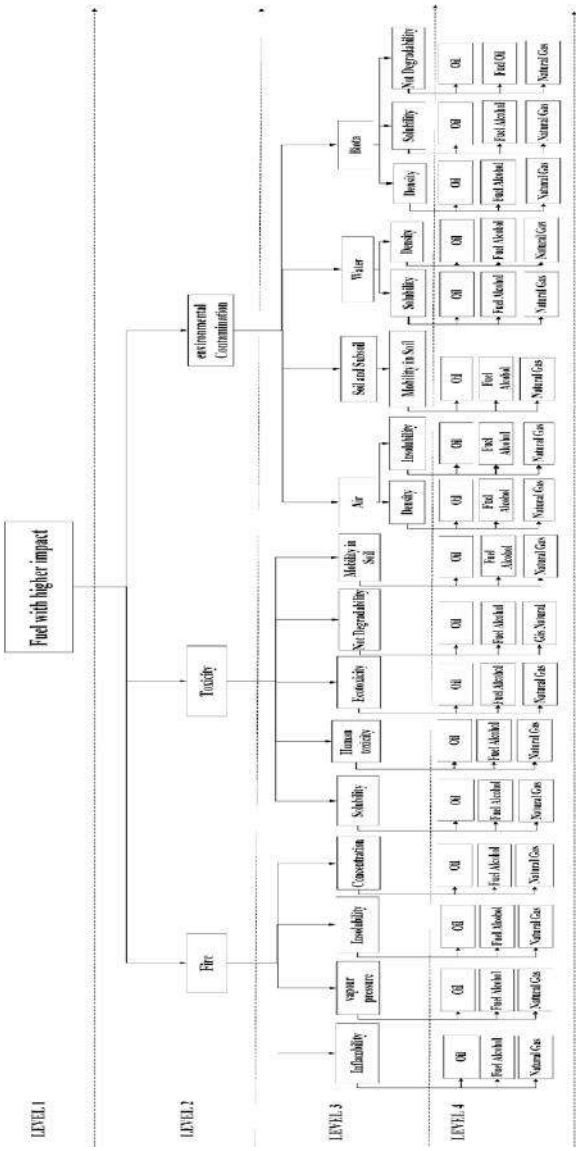

Fig.4: Hierarchical spreadsheet of the associate impact of spillage fuels

2.2 Comparison matrix of scale

The comparison stage needed to be carried out between the established criteria showed in the spreadsheet. Before this stage, was performed a meeting with a specialized group integrated by EMAE experienced analysts on environmental management and sustainability.

The judgment and its importance of an alternative over other ones was made subjectively, converting these judgments in numeric values, using a scale from 1 to 9 points as the AHP method indicates. Where 1 denotes equal importance and 9 denotes high degree of favoritism of an alternative over another.

The group of analysts made the comparison of levels 2 and 3 of the hierarchical spreadsheet of the associated impact of spillage fuels. The judgments of the last spreadsheet level were made from the comparison of numerical and qualitative values of the physicochemical properties of fuels (natural gas, oil and fuel alcohol) chosen for this analysis.

It was discussed that, fire is a consequence which represents the lowest impact on the easement areas. This consequence could be controlled by authorities, can be controlled by the carrier by means of a closure valve or finally with a stop in the operation. The toxicity, as well known, affect aquatic life and the ground. One of the most important uses of the dam is the water supply associated with the generation of energy through the energy complex Henry Borden. An area affected by fuel spillage prevents largely these activities (water supply and power generation which) according to the information revealed by EMAE, these leads to many problems for that the impacts of toxicity has the major value. Table 1 presents an example of how should be made the comparison matrices between each level, in this case, this matrix is the comparison matrix of level 2 of the spreadsheet.

Table 1: Comparison Matrix of level 2

MATRIX A	**Fire**	**Toxicity**	**Environmental Contamination**
Fire	1	1/3	1/3
Toxicity	3	1	1
Environmental Contamination	3	1	1

This treatment of judgments for each case of the matrices is performed in the same manner. Regarding the needed calculation to confirm the consistency of judgments in the decision-making group, it is specified that these are made by software EXPERT CHOICE®. The manual method for obtaining a measure of the consistency of judgment values may be performed according to the equations present in the Analytic Hierarchy Process (AHP).

After the development of these steps and obtaining a fewer judgments consistency than 0.10 as specified, the numerical values obtained of the final criteria are reliable, which is summarized with the inexistence of judgments inconsistencies between themselves. In this stage of the process, it is the moment to justify and analyze the results presented by AHP.

III. RESULTS AND DISCUSSION

The three main consequences of fuel leakage (level 2 of hierarchy) are presented.

3.1 Fire

https://dx.doi.org/10.22161/ijaers.69.9 *ISSN: 2349-6495(P) | 2456-1908(O)*

It was argued, that of the three consequences, the fire can generate on the areas the less impact. This event is an unusual event on those areas due to moisture that they present, the risk of explosion is not present. Moreover, it can be easily controlled by authorities due to constant monitoring. Environmentally speaking, the damage can be of great importance and magnitude, as in the case of the event happening in protected environmental areas, the destruction of typical vegetation could lead to several changes in ecosystems. Nevertheless, for the fire to reach this magnitude it needs proper conflagration conditions and a long time of conflagration.

The software presents a concentration (inflammability limits) as the property with the highest influence on to generate fire, it has a numerical value of 0.607, followed by igniting with a 0.243 value, fuel vapor pressure with 0.101 and insolubility with 0.049 value.

3.2 Toxicity

The toxicity affects aquatic life and terrestrial life. After a chemical leak (fuel) the seriousness of consequence is directly related to the type and amount of leaked fuel. The possibility of death for inhalation incident or consumption of the substance is big both for animals and for the general population.

The high impact index is due to different dam uses Billings, as a water supply associated with the generation of energy through the Henry Borden energy complex. An affected area with shedding needs degradation and cleaning treatments, both for the soil as the water, depending on the affected area may or may not be recovered in its entirety.

The toxicity, according to the values obtained by the EXPERT CHOICE®, the property of human toxicity represents the most important property to quantify a toxicity event with an associated value of 0.482. The eco-toxicity is in second place with a value of 0.218.

3.3 Environmental Contamination

Contamination is a consequence that affects ecosystems and wildlife. The degree of severity depends on the fuel type and the amount leaked, but the consequences may lead to animals' death. The study focused on the criterion of environmental contamination, it was divided into four types of environments that may be affected, according to the discussion with the decision-maker group these ambient are: soil and subsoil, water, air and biota.

The properties of environmental contamination event are defined by affectation areas: biota, soil and subsoil, air and water. The values obtained by evaluation in the software are shown in Table 2, it is seen that the areas with the highest affectation in the case of leakage, are water and soil, with numerical values of 0.560 and 0.249, respectively. For other affectation areas, the biota (0.095) and the air (0.095) had low values of influence of environmental contamination.

In Table 2 it is summarized and explained the mentioned values obtained by AHP above. It can be evident that the fire has a value of 0.146 and the lowest impact, compared with the toxicity and contamination event with 0.429 impact value for each one.

Table 2 - Impact assessment associated with the leak

Consequence	Impact
Fire	0.146
Toxicity	0.429
Environmental Contamination	0.429
-Air	0.095
-Soil and subsoil	0.249
-Water	0.560
-Biota	0.095

The next table presents the final values obtained by EXPERT CHOICE® software, regarding the goal of the AHP (associated fuel with the highest impact)

The evaluation by AHP shows that oil has an associated impact value of 0.390, while the fuel ethanol has a value of 0.361 and the natural gas obtained a value of 0.249, presenting the lowest value. The oil has a higher potential impact related to ethanol-based fuel. Natural gas despites of their clear potential fire, it is the fuel that could generate less impact in case of leakage.

This analysis is presented by the judgments based on the significance of impacts on the areas in the Billings reservoir. Depending on the study focus and the importance provided to each of the criteria, the final values obtained may differ.

Finally, Table 3 shows the fuel impact on associated values to be transported. In this table, the fuel with the highest impact value is the oil with a value of 0.390 followed by the alcohol fuel having a value of 0.360 and finally the natural gas with a value of 0.249 as the fuel with less impact associated of the three studied fuels.

Table 3: Fuel with highest associated impact

Fuel	Impact
Oil	0.390
Alcohol-based fuel	0.361
Natural gas	0.249

https://dx.doi.org/10.22161/ijaers.69.9 ISSN: 2349-6495(P) | 2456-1908(O)

The toxicity caused by the amount of leaked gas depends directly on pressure, heat and transported flow (ROSENBAUM, 2011). If the gas leak does not generate fire or explosion, the impact of toxicity on the affected areas will be higher due to the concentration of leaked gas in the áreas. Leaks can occur in inaccessible places where emergency operations are not to be effected. These leaks also can occur in different scenarios. In rural areas, as in environments with the presence of protected areas, damage or final impact will depend directly to the place where the leak occurs and the amount of leaked fuel. In water, natural gas tends to go over the surface, where it will dissipate in the air, causing a low concentration. Previously mentioned, natural gas has a low potential for contamination and low potential for toxicity because, in contact with the environment, it dissipates. That is the reason for the lowest potential impact of natural gas compared to fuel ethanol and oil.

The main damage caused by oil leaks is contamination, fire and toxicity. The oil affects the soil, groundwater, water and air environments, due to the properties that the oil has (vapor pressure, density, flammability, insolubility) (BONVICINI, 2015).

Oil spills result in significant contamination in relation to other fuels, due to the persistence of oil in water and land. According to works conducted the toxicity caused by contamination is high due to toxic compounds (polycyclic aromatic and other compounds present in the oil) (TRONCZYNSKY, 2004).

The alcohol may be degraded rapidly, its toxicity in human and environment depends on the leaked quantity and the area where the leak occurs. The dilution factor in water is an important factor to determine the degree of contamination, toxicity and pollution. Generally, fuel ethanol does not generate toxicity and pollution problems. It is necessary a large amount of ethanol to generate impact. Alcohol has a strong affinity with to potentiate fire, in reason of their concentration limits are low compared to natural gas. It is toxic with high solubility and mobility in soil, which also represents a high potential to reach any areas even if the leakage occurred in only one area. This is what allows that alcohol has a potential medium impact compared to natural gas and oil.

IV. CONCLUSION

The criteria and sub-criteria evaluated showed oil as fuel with the highest potential impact in a ratio of 1.57 times, regarding the natural gas that presented the lowest impact. The fuel alcohol presents a high impact on the potential areas, but a minor impact generated compared to oil, having a ratio of 1.45 times higher referred to natural gas. Natural gas is considered, among the three fuels, the lowest potential impact on the areas to be affected. In this study, the toxicity, polluting and inflammable power of oil was evidenced. Alcohol has power as the combustible oil and natural gas, but due to its ability to generate the media toxicity and contamination; this appears as a fuel with lower associated impact. In the case of natural gas, the only event that was able to identify is the average potential fire making this a fuel with low associated risk compared to other fuels.

From these results, it can be concluded that the AHP has shown its ability to deal with problems involving both quantitative and qualitative variables. The evaluation of the environmental issues surrounding the fuel type, the properties associated with these fuels, among other multi-criteria components scenario where the AHP has satisfactorily responded to such demands. It is necessary to verify the importance of the available data for the criteria evaluation. Not only the quantity and quality of data to be relevant, so was the way the information was translated into the values for the criteria.

ACKNOWLEDGEMENTS

Authors appreciate Agência Nacional de Energia Elétrica (ANEEL) for financing this project.

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https://dx.doi.org/10.22161/ijaers.69.10 *ISSN: 2349-6495(P) | 2456-1908(O)*

Importance of Training of Public Managers by Distance Education

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Abstract**—** *This work refers to a research carried out with the objective of emphasizing the importance of the training of public managers through training in the distance modality. In order to reach the proposed objective and respond to the research problem, we used the exploratory research and case study, as well as reviewing the literature allowing the deepening of the study. It emerged from the research that the skills required of managers are technical, intellectual, cognitive, relational, didactic and pedagogical, methodological, leadership and organizational. However, it has been identified that there are suggestions for improvement, such as specific trainings (courses) for managers, being better qualified for this type of education (distance), as well as training in the area of people management, to better understand the philosophy of Distance Education (DE), making institutions have more specific rules for the organization in this type of learning. Therefore, regardless of behavioral and context knowledge, the Public Manager is required to master the main managerial techniques in the organizational field and its human, financial and production resources and knowledge in public management, evidently referenced in an ethical commitment with the construction of a just society.*

Keywords**— Distance Education (DE). Training of Public Managers. Organizational skills.**

I. INTRODUCTION

The Education has been characterized over the years as an instrument by which governments seek to minimize social differences. In order to achieve this important goal, governments have been looking for different strategies and not just the traditional technologies used in the classroom (LITTO, FORMIGA, 2009).

With the changes that have taken place since the end of the 20th century in the labor market, brought about by new technologies, such as videoconferencing, multimedia courses on CD-DVD ROM and the internet itself, people began to have more access to information and, consequently, opening new possibilities in terms of teaching and learning, which expand traditional boundaries. This change allowed that the physical presence of students in the classroom was not also considered an indispensable condition for learning. From this, Distance Education (DE) began to gain space in educational institutions (RUMBLE, 2003).

However, this also requires better training of professionals to face the new challenges imposed by the new technologies on the education professionals.

DE offers a great contribution to people because it allows people to attend school in a more flexible and adequate way to their reality. The popularization of the use of computers and the advancement of the Internet allowed an expansion of the DE and resulted in the great challenge of knowing if people are prepared for this new type of education.

The Open University of Brazil (UAB) Project was created by the Ministry of Education (MEC) in 2005, within the scope of the Forum of State for Education, for the articulation and integration of a National DE System, on an experimental basis, with a view to systematizing the actions, programs, projects and activities pertaining to the public policies aimed at the expansion and internalization of the offer of free and quality higher education in Brazil UAB (PEDAGOGICAL PROJECT OF THE BACHELOR COURSE IN PUBLIC ADMINISTRATION MODALITY DISTANCE, 2009).

https://dx.doi.org/10.22161/ijaers.69.10 ISSN: 2349-6495(P) | 2456-1908(O)

The Bachelor's Degree in Public Administration of the National Public Administration Training Program (PNAP), in turn, is inserted in this context and responds to the needs of contemporary public organizations, which seek prepared, innovative managers with a broad vision of the reality that surrounds them the government context, trained. Within this Program, the *Lato sensu* Postgraduate Course in Municipal Public Management (DE) was offered at the Federal University of Santa Catarina (UFSC), with the purpose of training the public management of several regions of Santa Catarina and Rio de Janeiro Great Southern.

The objective of this work is to emphasize the importance of the training of public managers through the distance modality.

II. THEORETICAL FOUNDATION

Competences are the qualities that people need to possess so they can develop their work efficiently and effectively (DUTRA, 2000). The concepts and characteristics of competencies will be addressed in this section.

Competence can then be defined as the set of qualifications that the person must possess to perform a certain type of work with a higher level of performance (GIL, 2006). The concept of competence is strictly related to the development of the individual, and to continuous training, that is, the opportunity to improve or adapt skills.

For Resende (2003: 32), competence "is the transformation of knowledge, skills, abilities, interest, will, etc. in practical results. Having knowledge and experience and not knowing how to apply them in favor of an objective, a need, a commitment means not being competent. " Fleury (2002 apud BENETTI et al., 2005) defines competence as a responsible and recognized responsible knowledge that involves mobilizing, integrating, transferring knowledge, resources, skills, that add economic value to the organization and social value to the individual.

According to Ruzzarin, Amaral and Siminovschi (2002), it is possible to affirm that the French School developed a conception of competences very widespread in the business and academic circles, whose classification is based on three fundamental elements: (a) knowledge (knowledge); (b) know how to do (skills) and (c) know how to be (attitudes).

These skills (knowledge, skills and attitudes) to be developed in professionals can and should be developed with programs of development of people that, in addition to the question of the valuation of the professional, bring advantages to the institution of education through the management and investment of skills and knowledge (BENETTI et al., 2005).

Attitude is the main component of competence, which corresponds to a set of values, beliefs and principles formed throughout life, which thus determine the attitude of people. These behaviors are manifested in the face of everyday situations and tasks that develop in the day- to-day, among others, that mean the wanting to do. That is, it would participate in a competition and negotiate (GRAMIGNA 2002).

According to Resende (2003), the competences can be classified in different types: (a) techniques: domain only of certain specialties; b) intellectuals: applications of mental skills; (c) cognitive: mixed intellectual capacity with mastery of knowledge; (d) relational: involve practical activities of relationships and interactions; (e) social and political: relations and participation in society; (f) didactic-pedagogical: focused on education and teaching; (g) methodological: techniques and means of organizing activities and works; (h) leadership: personal skills and knowledge of techniques to influence and lead people; (i) organizational: organizational and business management skills.

The literature on DE is quite vague in the context of history. His embryo can be traced back to Plato's time (427-347 BC), at the time when that philosopher wrote a collection of letters and more than thirty philosophical dialogues, notably in his Discourse on Socrates, in which he defended this in the trial that sentenced him to death (SCHNEIDER, 1999 apud MELO, COLLOSSI, 2004).

The emergence of DE dates back to the 15th century, when Johannes Guttenberg, in Germany, composed the words using mobile characters (ALVES, 1994). Since then, the book has been read not only at school, at home and in the most varied places.

As a consequence, DE followed a progressive consolidation path, and this teaching modality is perceived by Moore and Kearsley (2008) where they find three stages, defined as first, second and third generation courses.

The dynamics of technology and the growth of information, linked to the generation of new products, have posed challenges to organizations in their economic and administrative life. According to Maia (2000), these challenges, coupled with new theories, are demanding continuous reassessment of work and solutions with

https://dx.doi.org/10.22161/ijaers.69.10 ISSN: 2349-6495(P) | 2456-1908(O)

quality differentials and short deadlines, so that companies survive competitiveness.

For a better understanding of the influence imposed on the educational process at the time of the Industrial Revolution, it is enough to realize that during this period the production line was segmented and the product massified, following the model advocated by Ford and the capitalist system, making the educational field prone to new ideas and methods that, at the same time as equalizing knowledge, also allowed to open the opportunity of innovation, being a favorable path for the DE. In this phase, the DE was identified as a model of industrial education in which planning occurs to ensure the development of the proposed actions in the teaching-learning process (BELLONI, 2009).

For the United Nations Educational, Scientific and Cultural Organization (UNESCO) (1998), DE is an innovative factor in education systems because of its applicability to creating, improving and overcoming current problems. With this, sufficient learning strategies are established to respond to the new requests of the students and the social demands, hitherto unknown or nonexistent.

According to a report by the Industrial Research and Development Advisory Committee (IDARC), the importance of DE can be translated as an Information Revolution, characterized by one of the increasingly powerful devices for storing, manipulating and recovering knowledge and to control the production processes, which are causing a large part of the previous education and training to be out of date or simply useless.

"Useful knowledge has an average life of ten years, intellectual capital depreciates around 7% a year (a much higher rate than the hiring of new employees), with the consequent reduction of the effectiveness of the labor force, work "(MELO, COLLOSSI, 2004, p.193).

DE is an innovative development in higher education that uses technology to facilitate learning without the constraints of time or place. A learning community must necessarily be associated with a physical location: a school, a university, a class or a laboratory. With the advent of technology, the new notion of learning community has moved into virtual space (MAIA; MEIRELLES, 2002).

Depending on the complexity of the project, especially the scope and scale of service, the number of professionals involved and the distribution of roles may vary. It is normal to find institutions that maintain a fixed staff in their functional frameworks and another variable, outsourced or not, contracted on demand. Even institutions varying in the organization of their structures, some professional profiles are typical of DE projects, regardless of the scope and the predominantly used technologies (LITTO and FORMIGA, 2009).

Meyer Jr and Murphy (2003, p. 102) expose the DE when it is passive, and present interagent orientation:

Passive distancelearning does not give rise to questions and answers between teachers and students and the evaluation of student performance is also more difficult. Interactive communication over the internet enables dialogue and an efficient assessment of student learning. Just as the printing industry has made higher education available on a previously unimaginable scale, interactive distance education promises to increase that scale again.

The DE is an important resource because it is an appropriate way to attend large contingents of students more effectively than other modality and without risk of reducing the quality of services offered as a result of the expansion of the clientele served (NUNES, 2010).

Due to the growth of DE, there is a need for training policies and strategies for the continuous improvement of this teaching. Without this, it is difficult to expand and recognize this form of education (UNESCO, 1998).

The DE counts with different organizations involved, such as private institutions, open universities, class entities, software companies, international programs, among others. "There are clear indicators that show that open and distance learning will be adopted and integrated by conventional institutions, probably at all levels of education and in all sectors" (UNESCO, 1998, p.35).

One of the most striking features of DE is the physical separation between teacher and students for most of the time. In order to communicate, it is necessary to mediate the media, media used in the course (printed material, audio, video, teleconference, video conferencing, internet, software, among others) that act as a filter in communication, differentiating it from the classroom. In the face-to-face class, even if the students' participation is restricted by shyness, or by the number of students in the same room, the teacher has a series of signals that allow interaction (RODRIGUES, 1998).

In the issue of scale, professionals must provide the necessary care in their planning. It is not mandatory to have a large public to start the DSA, but the planners will have to adapt to the particularities of their country, taking

https://dx.doi.org/10.22161/ijaers.69.10 ISSN: 2349-6495(P) | 2456-1908(O)

into account the language and social culture (UNESCO, 1998).

There is, however, a clear indication that yesterday's education is inadequate in response to the challenges of the future. The main concept of education continues to be that learning is accomplished once in a lifetime and is essentially undertaken in preparation for the rest of it (UNESCO, 1996).

Distance learning planning is seen as an indispensable tool for successful teaching. Faced with many challenges that will come, education is an indispensable tool for humanity to progress in the ideals of peace, freedom and social justice. Educational policies are a permanent process of enriching knowledge, technical capacity and, above all, a privileged structure of people and relationships between individuals, groups and between nations (DELORES, 1996).

Many options of environments and systems for management of DE courses through the internet are available in the market for those interested in implementing a solution of this type of teaching in their organizations. Although these options can be differentiated by particular details such as user interface and interactivity, these solutions have converged to the same technology, the internet (GEDEDINE; TESTA; FREITAS, 2008).

A strategy for DE strategy, which needs to be part of the training role, should include harmonic goals, clear definition of objectives to be followed and coordination at national level, as well as national socioeconomic development policies (RUMBLE, 2003).

The lack of technological infrastructure is one of the major common problems of distance learning in developing countries, such as Brazil. In its planning, the DE can concentrate simple technologies as long as it has a balanced view, since new forms of technologies that are suitable for training are less costly than previous generations (UNITED NATIONS ORGANIZATION FOR EDUCATION, SCIENCE AND CULTURE, 1998).

The implementation of a Distance Education Center (CEAD) has been a common procedure of educational institutions as an organ capable of fulfilling this function in the management process, but there are still challenges to be overcome in its implementation. One of them refers to the strategic structuring and planning that really take care of the internal clients of CEAD, such as teachers, tutors (learning mediators), pedagogical team, material production, who are in the front line during the first months of functioning of CEAD (RIBEIRO, 2007).

Within the characteristics of the DE is communication and resources. The evolution of electronic media can be considered one of the major responsible for maximizing the use of remote systems. In this way, attendance to the student became possible in any place in the world, as long as the latter has access to technology and, especially, in real time, making the use of DE in educational programs increase considerably with the over the years (PACHECO, 2010).

Understanding DE as the process resulting from poly teaching, in which several actors contribute in the organization and production of its content in various media, pedagogical arrangement in technologically mediated learning activities, as well as believing that the evaluative activity in the process should be to take care that are peculiar to their peculiarities, the distinction between DE and traditional teaching is made (ROCHA, 2017).

It is the evaluation a transformative action that encourages the critical-reflexive capacity of intervention on a certain theme, information or knowledge, whose value is the transforming reflection in action. This, which is propelled to the new reflections, permanent of the educator on its reality, accompanies pari passu, the educando in its trajectory of knowledge construction (HOFFMANN, 2003).

In this sense, consider factors such as evaluation in process and continuous evaluation that takes into account the relationship between the action and the realities found, that is attentive to the daily diagnosis of the student, which considers the ability of the student to appropriate certain knowledge in activity of interactive-collaborative-cooperative learning, are the same as the reflexive basis for planning and control of learning performance in multimedia environments, connected and requiring teacher and student pedagogical-technological skills (ROCHA, 2017).

Changes in the contemporary world, in the face of the globalization of the economy and the explosion of information and communication technologies and, consequently, the configuration of a new paradigm of society, require the acquisition and application of new knowledge. In this new economic and social context, the DE has acquired great importance. As a consequence, a growing number of institutions take it up in their training programs to meet the demands that increase exponentially (FRIGOTTO and CIAVATTA, 2003).

Each day, evaluating in the DE becomes more complex the transformative reflection before the wealth

https://dx.doi.org/10.22161/ijaers.69.10 ISSN: 2349-6495(P) | 2456-1908(O)

of variables that interfere in the processes of planning, execution and management of the resulting results. Differently from the assessment in face-to-face education, in the DE, one observes the adherence to new criteria and modalities, in an attempt to increase the learning potential by the formative, continuous and summative modes, but without losing sight of the different forms and spaces learning, connection pedagogy and the flexibility of choosing new learning methods, times, spaces and partners. In addition to what should be considered relevant the profile of the student who has chosen this system as an educational option (ROCHA, 2017).

What characterizes the differentiation of DE in relation to face-to-face education is the teacher's responsibility not to be in the teacher as an individual, but in the institution that brings together teachers and specialists for the elaboration of the appropriate didactic material, in the accompaniment of the student in his / their learning. In the same way, the institution is responsible for the logistics of the use, guaranteeing the flow of the information of the bidirectional communication; in short, of the teacher-student didactic relationship (LOBO NETO, 1994).

They are developed as prerequisites for evaluating the following competences in the according to Rocha (2017):

a) Teaching and learning - encourage collaborative-cooperative learning, encourage autonomy. Articulate and strengthen learning by searching;

b) Cloud teaching - harnessing new skills for learning in social networks, in virtual learning communities, in M-Learning2, in Massive Open Online Courses (MOOCs), in Open Educational Resources (REAs) etc .;

c) Performance indicators - develop skills to plan and monitor indicators of quality through meaningful learning, indicators of cooperation and knowledge appropriation. Compliance indicators and results;

d) Context or nature - to evaluate without losing sight of the diversity of socio-cultural, socio-economic, socio-political, ethical, ideological or religious realities that mix in the virtual spaces and classrooms, beyond the four walls of the traditional school;

e) Learning styles - to develop competences for the differentiated look in the evaluation of cognitive, physical, emotional aspects more andragogic or more pedagogical (continuous pedagogical-andragogic); consider the divergent, assimilating, convergent and usable learning styles recommended by Kolb (1984); and

f) Technological-mediatic skills - to invest in the field of educational technologies for technologically mediated course or activity (ROCHA, 2017).

As in any organization facing difficulty, a Higher Education Institution (HEI) would be no different. Managing a DE requires a much greater diversity of knowledge than managing a school, high school or university and, as a whole, it will not be possible to recruit staff with this knowledge. The institution will have to develop its own staff until it reaches the diversity and depth of knowledge required. Realistically, this takes time, and it will not be an exaggeration to say that a new DE institution needs two to five years until the core of its staff reaches its full operational capacity (FREEMAN, 2003).

Didactics is the art of transmitting knowledge; is also described as the technique of teaching and using science in order to make learning more efficient. It can be placed between educational theories and pedagogical practice. Using it to engage the student will make learning even more meaningful. According to Carvalho (2008), this involvement will occur when the teacher creates the conditions for the student to learn and share the knowledge, through strategies and stimuli, the following conditions:

a) Discuss openly, always respecting opinions;

b) Know the expectations and needs of the student;

c) Orient instruction through feedback, an intrinsic agent in e-learning;

d) Integrate in an interdisciplinary and contextual manner all presented content;

e) Promote the collaborative construction of knowledge and always value student-student, teacher-student and vice versa relationships.

Due to the difference in the target audience, the learning conditions and processes are also very different. Distance learning may require or develop different skills and competencies than conventional education. It is possible to take advantage of the broader experience and to apply more immediately the knowledge acquired in the work or in living situations (PACHECO, 2010).

III. METHODOLOGY

The present work is characterized as a qualitative case study. The research is based on primary data, through the literature review pertinent to the theme.

Among the advantages of the qualitative approach are: emphasis on the subjective interpretation of individuals,

https://dx.doi.org/10.22161/ijaers.69.10 ISSN: 2349-6495(P) | 2456-1908(O)

delineation of the context of the research environment, not very structured approach, multiple sources of evidence, importance of the conception of organizational reality and proximity to the phenomenon studied, among others (BRYMAN , 1989). However, the emphasis of this approach is not on the structure of organizations. This is an important element to meet the researcher's interest. The concern is to unravel the unfolding of events that culminate in the results, whose main interest is not only in these, but how one came to them, contributing to explain why things (MIGUEL, 2012).

The study can also be classified as descriptive and applied research. This is justified because it is a study about a reality, with the objective of knowing the phenomenon and proposing solutions to the challenges and problems encountered (RICHARDSON, 1989).

The choice of the case study is justified by presenting a detailed account of a social phenomenon that involves, for example, its configuration, structure, activities, changes in time and relationship with other phenomena, as a method of visualizing social reality, using a set of techniques and usual research in social investigations such as interviews, participant observation, use of original documents, data collection and other pertinent. It constitutes a holistic and intensive description of a well-defined phenomenon (it can be a program, an institution, a person, a group of people, a process or a social unit), the qualitative case study. This shows that the interest of the researcher is more concerned with the understanding of social processes that occur in a given context, than between relations established in the discovery, in the interpretation, being much more than the simple verification of hypothesis (GODOI; .

Participant observation was also used, since one of the researchers worked in the management of the DE course related to PNAP. During the course (from the beginning of 2012 to the end of 2013), students' progress and behavior were observed, most of them being public servants (such as city councilors, municipal secretaries, among others). Observational data are obtained in their natural form and hence their importance (BARBETTA, REIS and BORNIA, 2010).

IV. RESULTS OF THE RESEARCH, FIGURES AND TABLES

To The Bachelor's Degree in Public Administration in the distance modality is offered by professionals linked to the Federal University of Santa Catarina (UFSC), mostly from the Department of Administration Sciences, within the UAB / MEC Program and in partnership with municipal governments. Its policy is the democratization of access and the internalization of a public education, free of charge and of quality (PEDAGOGICAL PROJECT OF THE BACHELOR COURSE IN PUBLIC ADMINISTRATION MODALITY AT DISTANCE, 2009).

The design of the Bachelor's Degree in Public Administration is aimed at training graduates able to act efficiently and effectively in the context of public management, in the light of ethics, seeking to contribute to the achievement of the objectives and development of governmental and non-governmental organizations, in order to enable them to meet the needs and the development of society (PEDAGOGICAL PROJECT OF THE BACHELOR COURSE IN PUBLIC ADMINISTRATION MODALITY AT DISTANCE, 2009).

The general objective of the course is to train professionals with a broad knowledge of Public Administration, capable of acting at the federal, state and municipal levels, competently administering governmental and non-governmental organizations in a proactive, democratic and ethical manner, taking into account view of the transformation and development of society and the country (PEDAGOGICAL PROJECT OF THE BACHELOR COURSE IN PUBLIC ADMINISTRATION MODALITY AT DISTANCE, 2009).

These are some of the main characteristics of the Pedagogical Project of the Bachelor's Degree in Public Administration (PNAP).

Within the PNAP, the Specialization Course in Municipal Public Management has as its objective the qualification of personnel of higher level aiming the exercise of managerial activities. Specifically, you want to:

a) to train managers to act in the administration of macro (government) and micro (organizational units) public systems;

b) to train professionals with adequate training to intervene in social, political and economic reality;

c) contribute to the improvement of the management of the activities carried out by the Brazilian State, at the federal, state and municipal levels; and

d) to contribute to the public manager developing a strategic vision of public affairs from the systematic and

https://dx.doi.org/10.22161/ijaers.69.10 *ISSN: 2349-6495(P) | 2456-1908(O)*

in-depth study of the administrative reality of the government or its productive units.

The course, for academics, will allow the professional growth of the student through:

a) orientation of the ability of critical thinking to the problems of government;

b) developing the ability to strategically analyze organizational / environment relationship issues rather than offering only operational solutions;

c) strengthening the ability to communicate through face-to-face and distance discussions (chats), case studies, written work and seminar presentations, among other aspects.

The Basic Module was composed of nine subjects of thirty hours each, making a total of two hundred and seventy hours.

In the evaluation of the course, among the questions asked after the end of the course, the question "The Course helped train professionals able to act in the public service?". Was considered in the average as "very good" (muito bom), this meeting the expectations of most students, as shown below:

The work was a theoretical research, based on the perception of the students (public managers in the majority) that carried out this specialization.

Fig. 1: Did the course help train professionals able to act in the public service?

V. CONCLUSION

In the conceptual, social and characteristics aspects of the DE, its results allow to conclude the recognition of its importance in the presented context. The lack of some specific DE standards for HEIs makes it difficult and time-consuming to reach desirable levels. Ideal to make special commissions to cause MEC and UFSC to elaborate norms for this purpose.

In environments where changes occur permanently and at high speed, still characterized by the scarcity of resources and the high level of competitiveness ordered by contemporary society, it is required that the professional responsible for conducting public organizations has developed their creativity, critical spirit and their ability to produce new knowledge.

Allied to this dynamic and flexible personality, an essential profile to ensure the good performance of the management professional, it is also necessary for the Public Manager to develop a strategic vision of public affairs, which can be obtained from a systematic and in-depth study the various areas of action in the field of Administration and the integration of these areas in terms of conceptual and analytical knowledge.

Thus, regardless of behavioral and context knowledge, the Public Manager is required to master the main managerial techniques in the organizational field and their human, financial and production resources and knowledge in public management, evidently referenced in a ethical commitment to building a just society.

To meet the expectations of this emerging society, we seek to train professionals with solid and modern competence, in full conditions of efficient and effective performance, concerned with the social relevance of the product of their work, presenting skills for proactivity and creativity; logical, critical and analytical reasoning; systemic and strategic vision for negotiations, decision making, leadership and teamwork.

The development of a fairer society, with a better distribution of income and permanent generation of jobs, is the consequence of a series of economic, social and political factors, being important the practices of organization and administration of the work, adopted in the society, during the course of its development process, both in the public area and in the organizational area. In this sense, the role reserved for training is of relevant importance, since the specialists specialists (managers and policy makers) will be able to intervene in the social, political and economic reality of the country.

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https://dx.doi.org/10.22161/ijaers.69.11 *ISSN: 2349-6495(P) | 2456-1908(O)*

Synthesis and Characterization of Doped Cerium Nanocatalysts Samples Through Nitrate Solutions Thermal Decomposition

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Abstract**—** *Ceria based catalysts doped with calcium, zinc, magnesium were synthesized to the future application in the fast pyrolysis biomass in order to improve the kinetics towards volatile hidrocarbons production. Through thermal treatment of nitrate aqueous solutions followed by calcination of the produced solid powder at 600ºC, solid solutions of CeO_2 doped with Ca, Zn and Mg have been successfully synthesized. The final solid samples have been characterized through X ray diffraction (XRD), scanning electron microscopy (SEM) and energy-dispersive spectroscopy (EDS), in order to evaluate both the elemental composition, as well as the nature and amount of each crystalline phase (Rietveld analysis). The results show that in all cases the desired solid solutions have been obtained, with a mean crystallite size lying in the range between 9.5nm to 34.9nm, suggesting the presence of nanostructured particles.*

Keywords**— CeO_2, Nitrate, Thermal Decomposition.**

I. INTRODUCTION

Catalysts applicability is rising, especially in chemical and petrochemical industries. The search for an ideal catalyst is incessant, especially in relation to factors that lead to deactivation or poisoning because nowadays the focus for a process is to have a good optimization and get high performance and stability. [1].

In heterogeneous catalysis, the surface area should be as higher as possible, in order to maximize the exposition of the catalyst surface to the reactive media, which maybe achieved with nanostructured catalysts. Oliveira et al. [2] and Ramos et al. [3], emphasized that thermal decomposition through nitrate solutions is a viable method for producing nanoparticle materials because they are attractive and generate a completely homogeneous dispersion of the second phases in the metal matrix. Thus, they can obtain superior surface area, proving to be a very promising method because it involves low temperatures and short synthesis time. According to the current literature, metal oxides are promising materials for use as nanocatalysts, as the acid and base sites can be optimized by inserting specific dopants and also due to the possibility of producing nanostructures by different synthesis approaches, such as butadiene and biodiesel production, which use heterogeneous catalysis to obtain quality and selectivity of materials [4,5].

In this context, ceria oxide (CeO_2) has gained considerable attention from scientific community, especially through its application as a three-way catalyst, thereby stimulating the conversion of oxidized pollutant molecules, such as CO and NOx to CO_2 and N_2, the high selectivity and conversion achieved, a consequence of significant oxygen mobility in the cubic crystalline structure [6]. Moreover, when used as a support for metallic particles, the resulting strong interaction contributes for the high selectivity observed [7].

Marinković et al. [8] verified that catalysts containing calcium oxide and magnesium oxide are promising materials to be used as heterogeneous catalysts in biodiesel production due to high efficiency in transesterification reaction. According to Borges and Díaz [9], CaO presents interesting properties for this kind of reaction such as high activity, long catalyst life and requires moderate reaction conditions. Ferreira [10] studied the pyrolysis process using two types of raw materials, sugarcane biomass and Macaúba pulp presscake. The obtained results indicated that CaO increased non-condensable gases levels supporting the idea that the catalyst application in the gasification process of biomass should increase in a near future, due to low cost and its favoring in relation to the synthesis gas with lower CO_2 formation, a possible byproduct of this process. In this context, Nokkosmäki

https://dx.doi.org/10.22161/ijaers.69.11 *ISSN: 2349-6495(P) | 2456-1908(O)*

[11] has shown that ZnO, a recognized basic oxide, can also function as an excellent catalyst for bio-oil formation through rapid pyrolysis of pine sawdust, improving the chemical stability of the treated oil and significantly increasing the viscosity of the oil. around 55%.

In the present work cerium oxide samples doped with calcium, zinc or magnesium were synthesized through co-precipitation from thermal treatment of aqueous nitrate solutions. Next, the synthesized materials were characterized by scanning electron microscopy and energy-dispersive spectroscopy (SEM/EDS) and X ray diffraction (XRD), in order to evaluate both the elemental chemical composition, and also to quantify the crystalline phases present, confirming the production of the ceria solid solutions of interest.

II. METHODOLOGY

2.1. Surface Mixed Oxide Synthesis

The synthesis procedure starts with preparation of 0.05 M aqueous solutions of analytical grade zinc ($Zn(NO_3)_2.6H_2O$), calcium ($Ca(NO_3)_2.4H_2O$) and magnesium ($Mg(NO_3)_2.6H_2O$) powders. Next, 75mL of each dopant solution was mixed with the same volume of a 0.1624 M aqueous cerium ($Ce(NO_3)_3.6H_2O$, PA) nitrate solution.

The final solution was then thermal treated in a blanket for 120 minutes reaching around 250°C and the resulting powders calcined at 600°C for 3 hours in muffle furnace, open to the atmosphere. Table 1 presents the dopant included in each sample, together with specific labels for future reference in the discussion of the results.

Table 1. Synthesized samples.

A. Sample	B. Dopant metal
C.	D.
E. A	**F.** Ca^{+2}
G. B	**H.** Mg^{+2}
I. C	**J.** Zn^{+2}

2.2. Characterization

After synthesis, each catalyst sample has been characterized through SEM/EDS, in order to evaluate both surface morphology and elemental chemical composition. For accomplish this analysis, a HITASHI tabletop microscope was employed, model TM 3000, which works with back scattered electrons and 15kV accelerating voltage.

For the identification/quantification of the crystalline phases formed, XRD analysis has been performed through use of a Bruker diffractometer, model Discover 8, which works with Cu source and is equipped with a high precision lynxeye detector. The XRD data was next analyzed through Rietveld method with fundamental parameters, which has been applied through use of software TOPAS 5.0 (Bruker). This analysis was especially important for the research, in order to confirm that the doping process has been successful, as well as for the evaluation of the sample mean crystallite size, a parameter directly related to the nanostructured content.

III. RESULTS AND DISCUSSION

On Figure 1 the XRD data for sample A can be seen. The Rietveld modelling has been performed with a CIF type file based on the structure published by Mohanty et al. [12], which consider a CeO_2 cubic solid solution, whereas the atomic fractions of Ce^{+4} and Ca^{+2} are respectively equal to 95 and 5%, and where kept constant during the refinement.

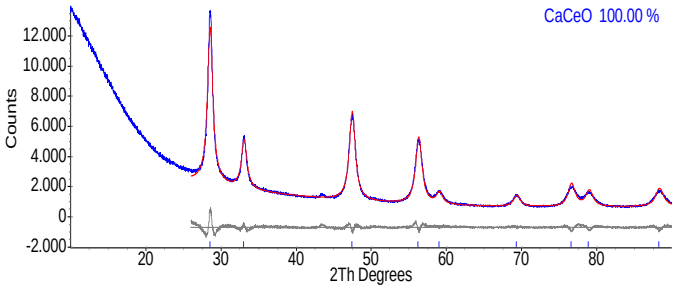


Fig.1: XRD data after Rietveld analysis from sample A.

The results point out the presence of a single crystalline phase of the mentioned solid solution, whose large diffraction peaks should be associated with the presence of nanostructured crystals. The quality of the Rietveld refinement can be attested as of quantitative level, indicated by the gray bottom line, which depicts the difference between experimental and calculated diffraction intensities.

On Figures 2 and 3, the results from SEM/EDS analysis performed on sample A can be observed. The gray scale contrast suggests the presence of a monophasic material in accordance to the information obtained by the Rietveld analysis (Figure 1).

https://dx.doi.org/10.22161/ijaers.69.11 *ISSN: 2349-6495(P) | 2456-1908(O)*

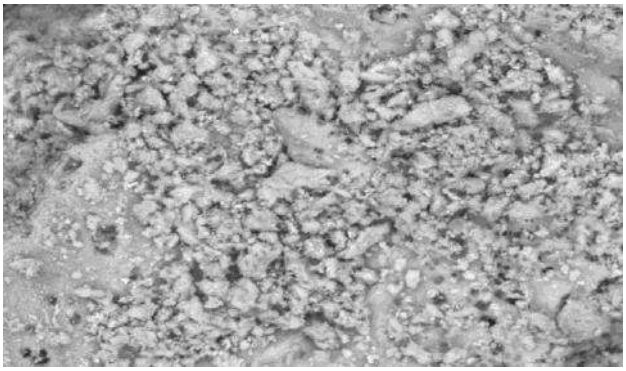


Fig.2: SEM micrograph of catalyst sample A (magnified 2000X).

As expected, the chemical composition determined through EDS (Figure 3), indicates the presence of Ce, O and Ca atoms, Ce and O being the atomic entities of much higher concentration, both explained by the fact that CeO_2 plays the role of a solvent, and CaO the solute. The peak not labeled, localized around 1,5 kev, and which is present in the EDS signals of all other samples, should be associated to aluminum, an element contained in the sample holder.

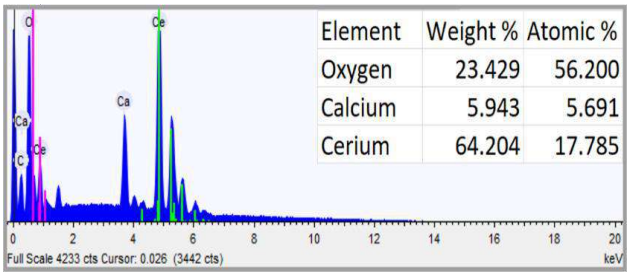
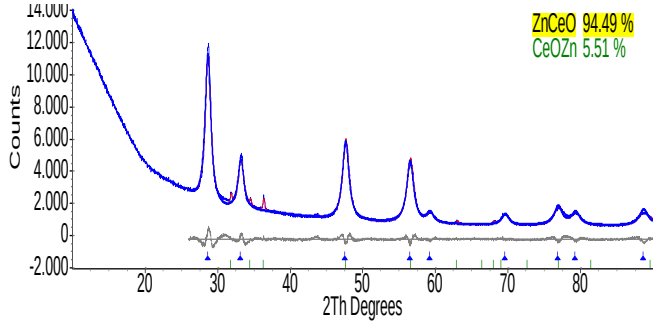


Fig.3: EDS signal and elemental composition of catalyst sample A.

On Figure 4 the result from Rietveld refinement of XRD data of sample B can be observed, which was achieved based on CIF files constructed from data of Wook [13] and Torres-Huerta [14].



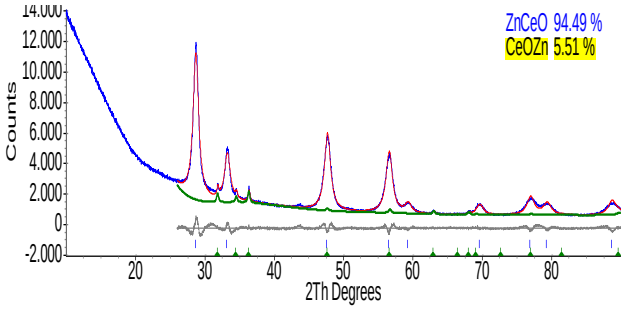


Fig.4: XRD data after Rietveld analysis from sample B.

As in case of sample A, the presence of large peaks suggests a significant nanostructured content. The assessment quality is evident from the very low difference between experimental and calculated intensities. According to Figure 4 is realized that this sample has two different solid phases. In the cubic structure, CeO_2, majority element, was doped with 3% of zinc, dopant element. For the other one, cerium as dopant element was incorporated into the zinc structure. The main explanation for this existence is that the solubility limit of zinc in the ceria structure could be reached.

The micrograph obtained through SEM of sample B is presented on Figure 5. A careful look at the micrograph shows that the gray scale contrast is not uniform, suggesting that the distribution of Zn and Ce should not be uniform, which could be explained by the hypothesis that two phases are present, as confirmed through XRD analysis (Figure 4).

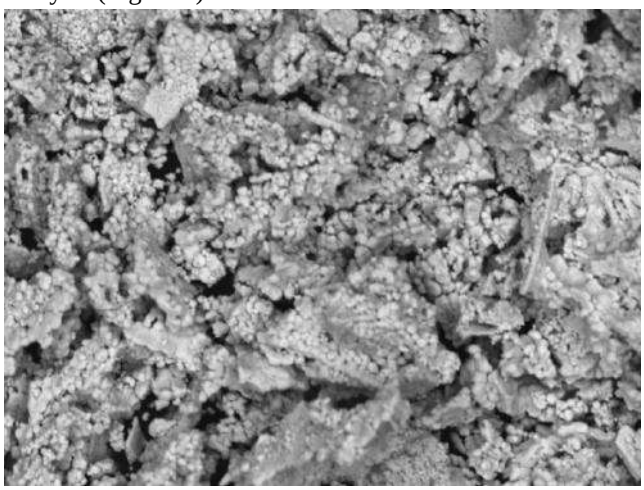


Fig.5: SEM micrograph of catalyst sample B (magnified 2000X).

The EDS spectrum of the area depicted on Figure 5 is in accordance to the expectations, the mass fraction of Zn, the dopant, much lower than the one for Ce.

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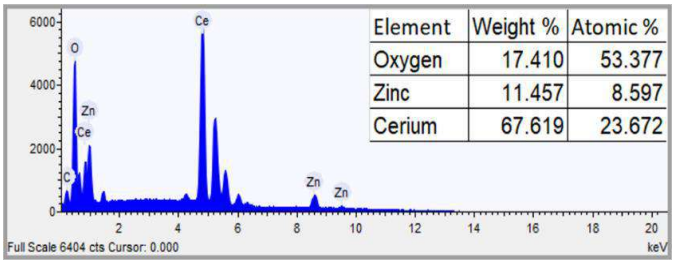

Fig.6: EDS signal and elemental composition of catalyst sample B.

Figure 7 depicts the refinement of sample C XRD data. The Rietveld method was executed with a CIF file based MgO structure published by Boiocchi [15].

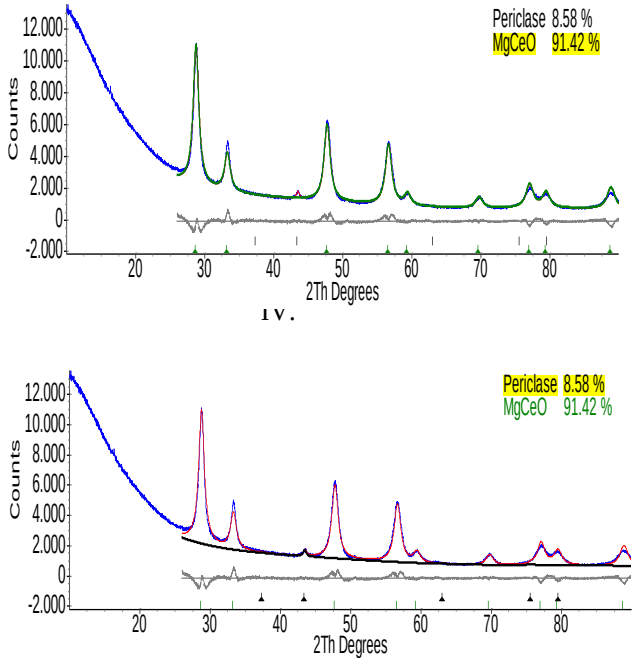

Fig.7: XRD data after Rietveld analysis from sample C.

The quality of the adjustments could be seen as a quantitative analysis due to model curve is sufficient close to the experimental values. The results show that there was obtained a nanostructured material confirmed by the extended peaks of the figure 7. The peak showed in 44 (2Th Degrees) refers to the MgO structure, indicating a small percentage of this structure in this sample, which suggest that the solubility limit of Mg was achieved.

Figure 8 presents a micrograph of sample C, and as in the case of sample B (Figure 6), some variations in the gray scale intensity can be also be detected, suggesting that the material should contain at least two phases, as confirmed through XRD analysis (Figure 7).

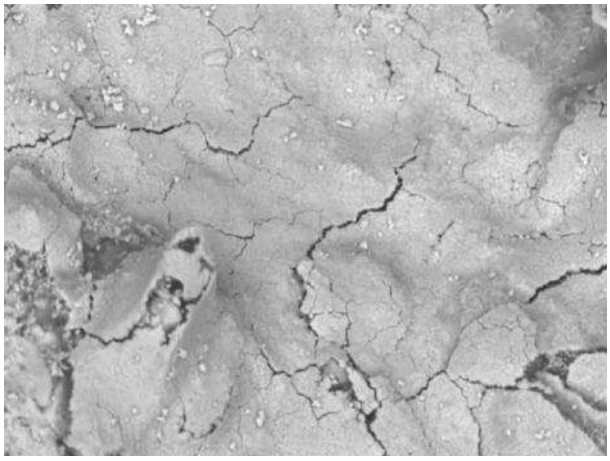

Fig.8: SEM micrograph of catalyst sample C (magnified 2000X).

On Figure 9, EDS data for sample C is presented. As in case of all other samples, Ce is the major element, followed by oxygen and the dopant, Mg in the present case. Besides the peak of aluminum (1,5 keV), no signals from impurities are observed.

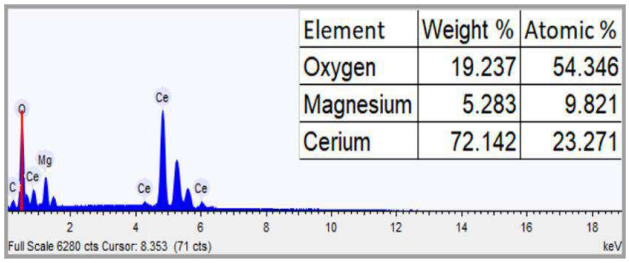

Fig.9: EDS signal and elemental composition of catalyst sample C.

As said before, the significant spreading of the diffraction peaks suggests the presence of crystalline regions with sizes in the nanometric range. Indeed, the determined crystallite average sizes during Rietveld analysis confirms this tendency (Table 2).

Table 2. Crystallite average size regarding each synthetized sample.

Sample	Crystallite average size (nm)
A	CaMgO - 10.8
B	ZnCeO - 9.5 ; CeOZn- 34.9
C	MgO- 20.2 ; MgCeO- 9.5

V. CONCLUSION

The synthesis of doped nanocatalysts based on ceria was shown to be effective by the thermal decomposition method, especially for the samples with Ca and Mg.

Through the XRD analysis and the quality of the graph adjustments in the quantitative levels by the Rietveld method, it can be concluded that the formation of nanostructured materials occurred, thus considering the successful reagent doping due to the extended peaks and their size. average crystallite between 9.5 nm and 34.9 nm.

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However, it can be noted that one of the cases occurred excess solubility. Mostly, the solids solutions of interest (CaO/CeO_2, ZnO/CeO_2, MgO/CeO_2) were formed. Due to the excess of MgO, and thus, its lack of solubility others crystalline phases were identified in samples B and C, being in the first sample a non-cubic structure with cerium incorporating on the structure of ZnO and in the second, in the presence of a small percentage of MgO on the structure of the material.

The results obtained by SEM confirm the monophasic nature of samples A and C due to the lack of color contrast in the micrographs, however, the data suggest that sample C presents more than one phase in the XDR. In the case of sample B, the gray contrasts present in the analysis confirm the synthesis of a biphasic material. The EDS spectra corroborate the expected elemental composition for each sample, indicating the absence of impurities, and the greater presence of Ce.

ACKNOWLEDGEMENTS

The authors would like to thank CNPQ for the research financial support, and also, the crystallography and x-ray diffraction laboratory from DEM/PUC-Rio (DEQM) for the XRD analysis.

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https://dx.doi.org/10.22161/ijaers.69.12 *ISSN: 2349-6495(P) | 2456-1908(O)*

Preparation, Structural and Magnetic Characterization of the $BaTi_{(1-x)}Mn_xO_3$ System

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Abstract*—The $BaTiO_3$ is one of the most studied ferroelectric materials mostly due to its great potential for technological applications. Recently, other properties have been explored in $BaTiO_3$, such as photoluminescence, photoacoustic and magnetism. These characteristics are mainly found when replacing the Ba and Ti ions by other transition metals or rare earths ions. The solid state reaction technique was used to prepare solid solutions of $BaTi_{(1-x)}Mn_xO_3$, in which the precursors $BaCO_3$, TiO_2 e MnO_2 were weighed according to desired stoichiometry, for x between ($0.001 \leq x \leq 0.1$) and placed in the mill for 24 hours. Then, the obtained solid solution was calcined at a temperature of 1200 ° C for 1 hour. After calcination, the solid solution $BaTi_{(1-x)}Mn_xO_3$, were analyzed by X-ray diffraction, scanning electron microscope and by a magnetometer vibrating sample to verify the existence of magnetic properties. The results presented in this work are satisfactory, where we obtained a multiferroic material.*

Keywords*—*$BaTiO_3$, Multiferroics, Magnetic Properties.

I. INTRODUCTION

The study and development of new materials are extremely important for the discovery of new technologies. Material science is directly linked to technological advances, and the manufacturing process is a determining factor for the properties of materials. Different manufacturing methods lead to different structural and microstructural properties, which are directly linked with mechanical, thermal, electrical and magnetic properties.

An example of material with great technological application is barium titanate, $BaTiO_3$. A ceramic material whose main property is ferroelectricity [1]. The $BaTiO_3$ was one of the first discovered materials to have a perovskite structure and has five solid state phases with symmetries: hexagonal, cubic, tetragonal, orthorhombic and rhombohedral, which have ferroelectricity, except for the cubic phase [2, 3]. Another characteristic of $BaTiO_3$ are the piezoelectricity and the high dielectric constant values, that are between 1500 and 2000 [4, 5], therefore, it can be used, for example, in capacitors, high voltage insulators, transducers, microphones and electro-optical devices [1,6]. Recently some other properties have been explored in the $BaTiO_3$, such as photoluminescence, photoacoustics and magnetism, these characteristics are mainly found when replacing Ba and Ti ions with other transition metals or rare earth ions.

The method generally used to obtain the $BaTiO_3$ is the solid state reaction, using as precursors $BaCO_3$ and TiO_2, this process is realized at temperatures higher than 1000 ºC [7]. The resulting grains of this synthesis method are not uniform and have an average size higher than 1 μm [8]. Impurities such as Barium Carbonate ($BaCO_3$) and other unwanted phases may appear during material synthesis [7]. Other methods of preparing the $BaTiO_3$ are high energy milling, sol-gel, hydrothermal synthesis and pechini [1, 9, 10]. The synthesis method directly influences the final properties of the material. Substitution is one of the forms to modify the microstructure, structure and other ceramic properties of $BaTiO_3$ [1]. These substitutions are determining factors for the applications of these ceramics and can be applied as high voltage insulators, semiconductors, ferroelectrics usable in the manufacture of capacitors and memories for computers [11]. In order to improve the electrical properties of the $BaTiO_3$, Ba and Ti

https://dx.doi.org/10.22161/ijaers.69.12 *ISSN: 2349-6495(P) | 2456-1908(O)*

ions are replaced by other elements such as Mn (manganese) for example, substitutions may be made in the material in the form of ceramic or in the form of thin film [12]. Another dominant characteristic regarding substitution for $BaTiO_3$, with the Mn ion is to make it a promising candidate when aiming for magnetic properties after substitution [13].

Presenting magnetic and ferroelectric properties after Mn substitution, the material can be classified as multiferroic and can present magnetoelectric effects, that is, appearance of a magnetization due to an electric field or appearance of an electrical polarization due to a magnetic field. This effect makes multiferroic materials extremely interesting for applications where the same material needs to perform more than one task and with that a crescent interest has been devoted to them. It has also been reported that double substitution by two transition metal ions, Fe and Mn for example, makes $BaTiO_3$ present excellent magnetic properties[13].

Thus, this work proposes to synthesize through the method of synthesis of the post-ceramic solid state of $BaTiO_3$ substitute Ti ions with Mn ions, forming the compound $BaTi_{(1-x)}Mn_{(x)}O_3$, which $0.001 \leq x \leq 0.1$. The objective is to obtain a material that presents in the same phase ferroelectricity and (anti)ferromagnetism and to study the effects of the substitution of Ti by the ions of Mn in the structural, microstructural and magnetic properties.

II. MATERIALS AND METHODS

Through the solid state reaction synthesis method, the solid solution was obtained $BaTi_{(1-x)}Mn_xO_3$, using the precursors $BaCO_3$, TiO_2 e MnO_2 with analytical purity.

The stoichiometric calculations through the molar masses of the compounds were performed and it was possible to verify the necessary masses of each precursor to produce 15 grams of $BaTi_{(1-x)}Mn_xO_3$, where the values are presented in Table 1, concentration varied in compositions between $0.001 \leq x \leq 0.1$, which were used for the stoichiometric calculations.

Table 1- Precursor masses for 15 grams of $BaTi_{(1-x)}Mn_xO_3$ calculated stoichiometrically

	PRECURSOR	MOLAR MASS	MASS (g)
Substitution (X=0.001)	$BaC0_3$	197.335	10.7058
	TiO_2	79.865	4.2895
	MnO_2	86.936	0.0047
Substitution (X=0.01)	$BaC0_3$	197.335	10.6756
	TiO_2	79.865	4.2774
	MnO_2	86.936	0.0470
Substitution (X=0.03)	$BaC0_3$	197.335	10.6701
	TiO_2	79.865	4.1888
	MnO_2	86.936	0.1410
Substitution (X=0.05)	$BaC0_3$	197.335	10.6647
	TiO_2	79.865	4.1004
	MnO_2	86.936	0.2349
Substitution (X=0.1)	$BaC0_3$	197.335	10.6511
	TiO_2	79.865	3.8796
	MnO_2	86.936	0.4692

After the calculations were performed, the compounds were weighed on an analytical balance with a tolerance of ± 0.0001g and mixed in a container. Then the materials ware mixed with distilled water and 10 mm diameter zirconium spheres, in order to fill the container volume. The container was sealed and taken to the mill where it rotated for 24 hours for the purpose of mixing the precursors. The mixture was then separated from the spheres and put in the microwave oven for periods ranging from 30 to 35 minutes, enough to dry the distilled water of the composition.

After the drying process, the material passed by thermic treatment (calcination) the temperature used was 1200ºC and the time was 1 hour for all compositions. X-ray diffraction was realized, data were obtained by means of an X-ray diffractometer with radiation CuKα with λ=1.5418 Å. The electrical voltage in the tube was 40kV, the electric current was 30mA and the scan mode used was fixed time, with a range of 20° to 80°, 0.02 step and 8 second time.

The diffractogram peaks were indexed with records from the international database JCPDS (Joint Committee for Powder Diffraction Studies). After the samples were finalized, observations were made in a scanning electron microscope model JEOL SM 5800 LV with orders of magnitude from about 5000 to 10000 times.

The determination of the magnetic hysteresis curve was obtained by a homemade the vibrating sample magnetometer, where the samples were submitted to vibration with the presence of a magnetic field, using a magnetometer to evaluate the magnetic field produced. Finally, using the unit cell volume obtained by X-ray diffraction and the unit cell mass, the theoretical density of the materials was calculated. Theoretic density is indicated by Equation 1, where m_c is the unit cell mass and V_c the unit cell volume.

$$\rho_{\text{theoretic}} = \frac{m_c}{V_c} \quad (1)$$

The unit cell volume in the tetragonal phase is calculated by Equation 2, where a, b and c are the lattice parameters of the cell. For the hexagonal symmetry unit cell, its volume is given by Equation 3. For both conditions, a=b≠c [16].

$$V_{ct} = a^2 . c \quad (2)$$

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$$V_{ch} = \frac{6a^2\sqrt{3}}{4}.a \quad (3)$$

The lattice parameters are obtained by the relation, for tetragonal symmetry, between the Miller indices and the interplanar distance d_{hkl}, presented in Equation 4 [14]. For the hexagonal phase the lattice parameters were obtained through Equation 5. The interplanar distance d_{hkl} can be obtained by applying Equation 6. For the calculation of the unit cell mass, the sum of the product of the atomic masses by the contributing atoms in the unit cell. Atomic mass can be calculated by Equation 7.

$$\frac{1}{d_{hkl}^2} = \frac{h^2+k^2}{a^2} + \frac{l^2}{c^2} \quad (4)$$

$$\frac{1}{d_{hkl}^2} = \frac{4}{3}\frac{h^2+h.k+k^2}{a^2} + \frac{l^2}{c^2} \quad (5)$$

$$d_{hkl} = \frac{n\lambda}{2\ \mathrm{L}\sin\theta} \quad (6)$$

$$m_{atomic} = \frac{m_{molar}}{N_A} \quad (7)$$

III. EXPERIMENTAL RESULTS

To discuss the results, this work was divided into: scanning electron microscopy (SEM) analysis, phase analysis of $BaTi_{(1-x)}Mn_xO_3$, tolerance factor, lattice parameters, density and magnetic hysteresis [17].

The Figures 1, 2, 3 and 4 show the SEM images. Figures 1 and 3 present the micrographs of the samples of pure $BaTiO_3$, while Figures 2 and 4 show the micrographs of the material $BaT_{(1-x)}Mn_xO_3$ with different substitution concentrations.

In the scanning electron microscopy analysis, a comparison was made between the pure $BaTiO_3$ and for the substitution concentrations of x=0.01 (Figure 2(a) and Figure 4(a)), it was found that the grains began to suffer a bonding between them but there was no change when compared the grain sizes.

In the sample analysis for x = 0.03 (Figures 2(b) and 4(b)) a larger bonding was found when compared to the composition with x = 0.01, and some grains started to reduce in size. For the concentration of x=0.05 as illustrated in the Figures 2(c) and 4(c), it was possible to identify a larger quantity of particles assuming smaller sizes and a bonding between them larger than those presented by the samples of smaller concentrations of Mn. Figures 2(d) and 4(d) shows the micrographs of the samples with x=0.1, in which it is possible to observe more accurately the reduction in the grain sizes and the manifestation of grains in rectangular forms. In this sample the bonding between them becomes even larger, certifying that with increasing concentration, the grains join significantly.

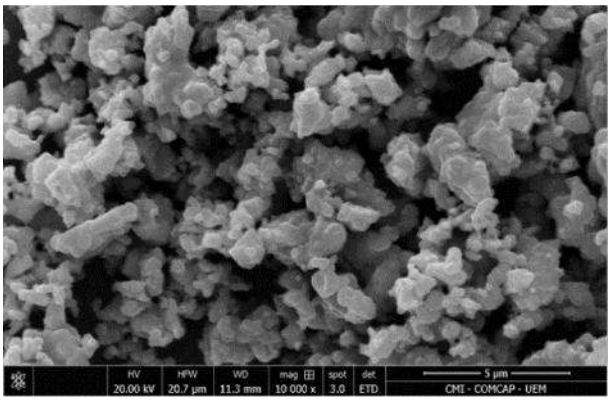
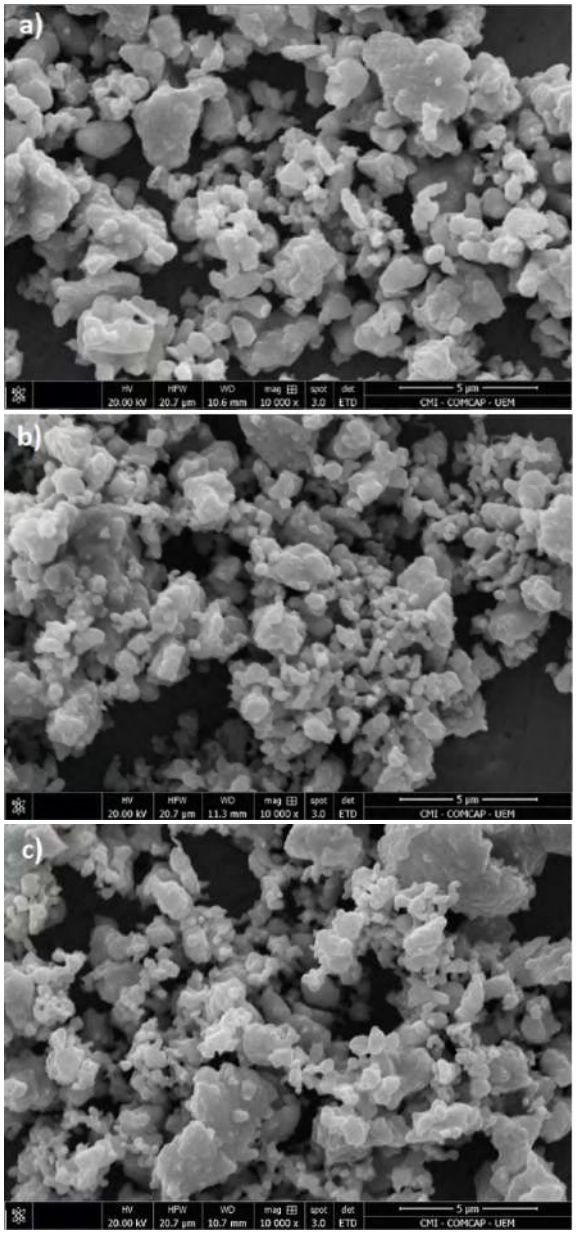


Fig. 1: Micrograph sample of $BaTi_{(1-x)}Mn_{(x)}O_3$ for x = 0



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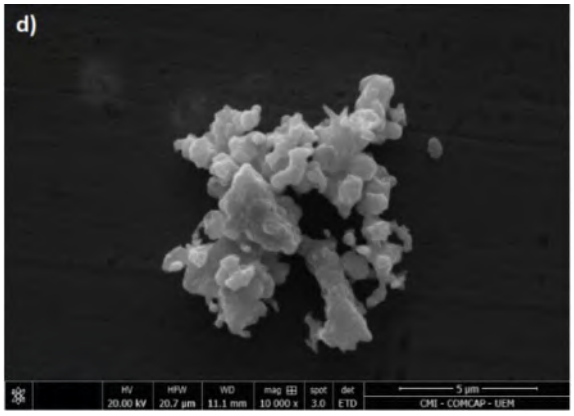

Fig. 2: Microstructural analysis of samples (a)$BaTi_{(1-x)}Mn_{(x)}O_3$ (x=0.01) (b) $BaTi_{(1-x)}Mn_{(x)}O_3$ (x=0.03) (c) $BaTi_{(1-x)}Mn_{(x)}O_3$ (x=0.05) (d) $BaTi_{(1-x)}Mn_{(x)}O_3$ (x=0.1)

Through the micrographs analysis it was possible to verify that the changes in the grains occur due to the substitution of the Ti ions by Mn in $BaTiO_3$, generating a reduction in grain size and when examined in relation to its distribution, it was found that there was a significant bonding between them.

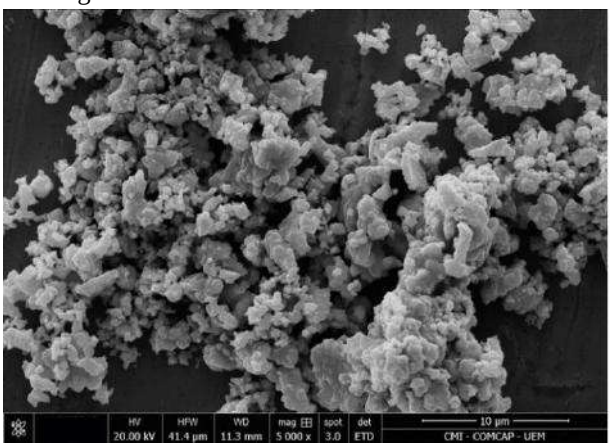

Fig. 3: Micrograph sample of $BaTi_{(1-x)}Mn_{(x)}O_3$ for x = 0

The phase analyzes of the of $BaTi_{(1-x)}Mn_xO_3$ samples were performed using the x-ray diffractometer, for the purpose of checking the purity of the material. Figure5 shows the diffractogram patterns of pure$BaTiO_3$ in a temperature range from 950ºC to 1200ºC. When calcined at a temperature of 950ºC a second phase can be observed, which for this case is $BaCO_3$, the peaks were identified with (●).

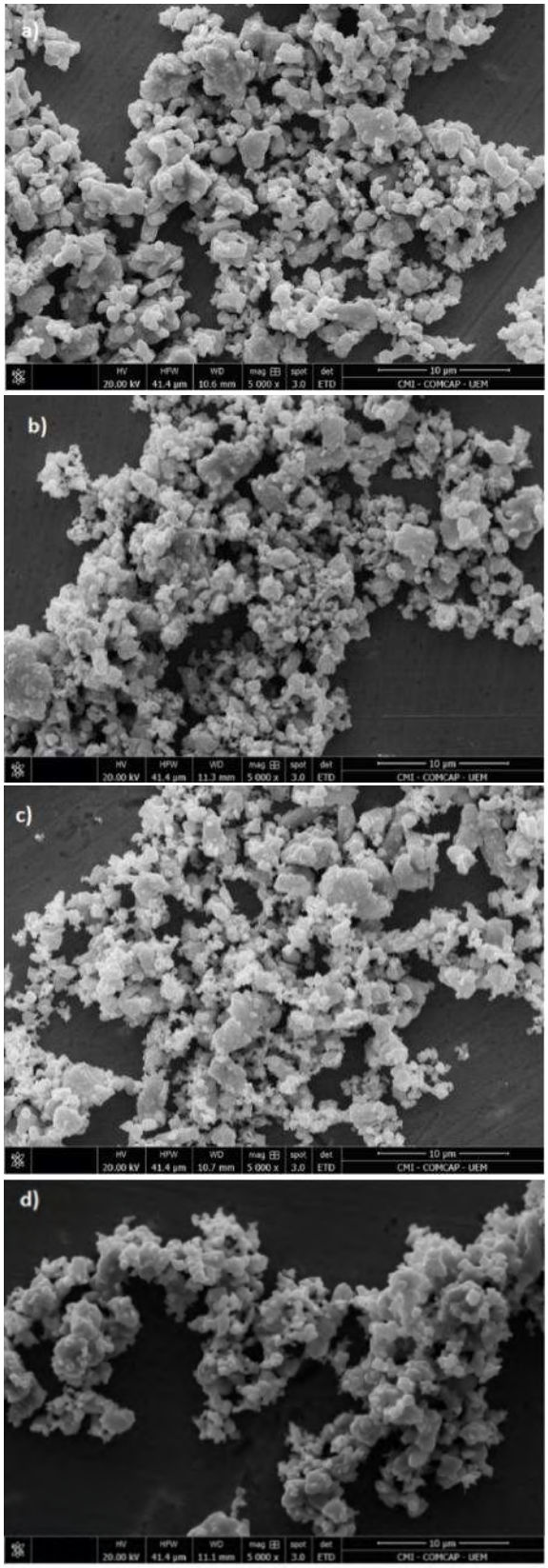

Fig. 4: Microstructural analysis of samples (a)$BaTi_{(1-x)}Mn_{(x)}O_3$ (x=0.01) (b) $BaTi_{(1-x)}Mn_{(x)}O_3$ (x=0.03) (c) $BaTi_{(1-x)}Mn_{(x)}O_3$ (x=0.05) (d) $BaTi_{(1-x)}Mn_{(x)}O_3$ (x=0.1).

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For pure $BaTiO_3$ calcined at 1000ºC, is the same situation where $BaCO_3$ is present as a secondary phase, but less evident. Already for pure $BaTiO_3$ calcined at 1100 ºC, $BaCO_3$ is present in a small amount, but a Ba_2TiO_4 phase is formed, marked with asterisk (*) in Figure 5. In the case of the pure $BaTiO_3$ calcined at 1150 ºC, the $BaCO_3$quantity seems is lower than the sample calcined at 1100ºC, but with a higher amount of Ba_2TiO_4, as shown in Figure 5.

And finally, the diffractogram of $BaTiO_3$solid solution calcined at 1200 ºC, presented the most satisfactory result, because when calcined at this temperature occurs the elimination of the $BaCO_3$ phase, leaving only the Ba_2TiO_4 phase, and thus presenting a smaller amount of impurities.

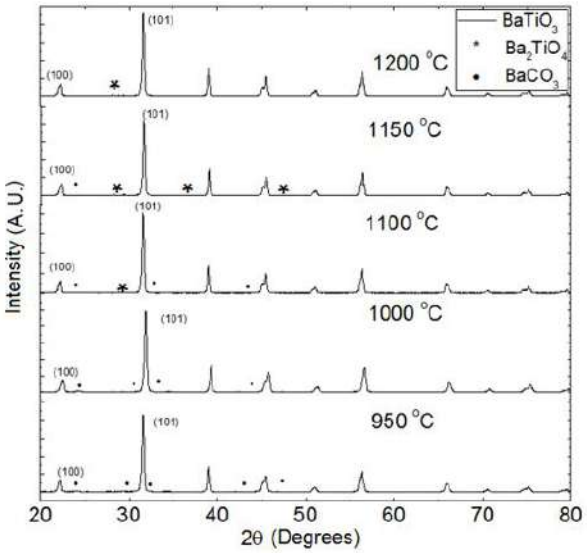

Fig. 5: Difratogram of $BaTiO_3$ calcined – Temperature between 950ºC and 1200ºC

Through X-ray diffraction insolid solution of $BaTi_{(1-x)}Mn_xO_3$ it was possible to verify the purity of the material and to identify the phases of the same, the diffractograms are presented in Figures 6, 7, 8, 9 and 10. Figure 6 is the diffractogram of $BaTi_{(1-x)}Mn_xO_3$ sample calcinated at 1200 ºC, with concentration of x=0.001, in which a second phase can be observed, which for this case is $BaCO_3$. Through data sheets JCPDS 75-1606 and 01-0506it was possible to obtain the symmetry of the material ($BaTi_{(1-x)}Mn_xO_3$), with tetragonal characteristics.

Figure 7 shows the diffractogram of $BaTi_{(1-x)}Mn_xO_3$ sample calcined at 1200ºC, with concentration of x=0.01, in which a second phase of $BaCO_3$ is also present, at the peaks with an asterisk, according to Figure5. In this composition it is still possible to observe that for $BaTi_{(1-x)}Mn_xO_3$ there is only the tetragonal phase, the data sheets obtained to find the symmetry of the material were JCPDS 75-1606 and 01-0506.

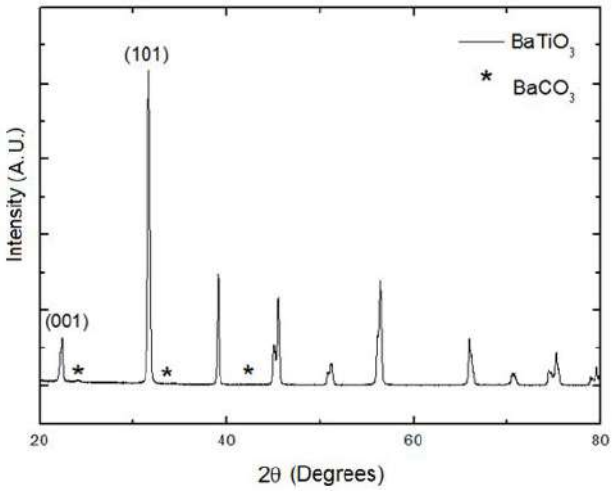

Fig. 6: Diffractogram of $BaTi_{(1-x)}Mn_xO_3$ calcined at 1200 ºC for x=0.001.

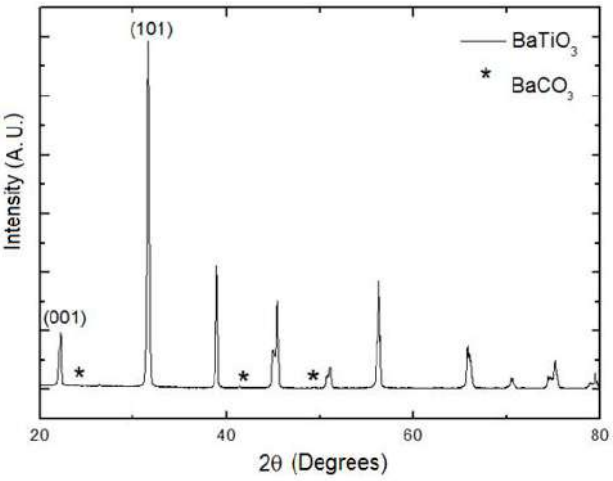

Fig. 7: Diffractogram of $BaTi_{(1-x)}Mn_xO_3$ calcined at 1200 ºC for x=0.01.

In Figure 8 with a higher substitution concentration (x=0.03) there is now hexagonal symmetry, beyond the tetragonal in the compound. Through the diffractogram it is also possible to identify the presence of the phase $BaCO_3$, the data sheets JCPDS used were 81-2201, 01-0506, 34-0129. Figure 9 with a concentration of x=0.05 the tetragonal and hexagonal symmetry remains in the compound, and it is still possible to identify the presence of $BaCO_3$ impurity.

And finally, in Figure 10, with the highest concentration of Mn (x = 0.1) it is possible to observe that the material has only hexagonal symmetry. Moreover, it presents impurity in its composition, $BaCO_3$, represented by the asterisk in the peaks.

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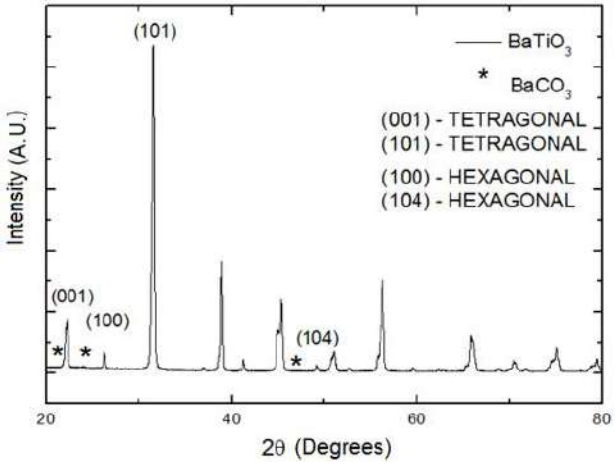

Fig. 8: Diffractogram of $BaTi_{(1-x)}Mn_xO_3$ calcined at 1200 ºC for x=0.03.

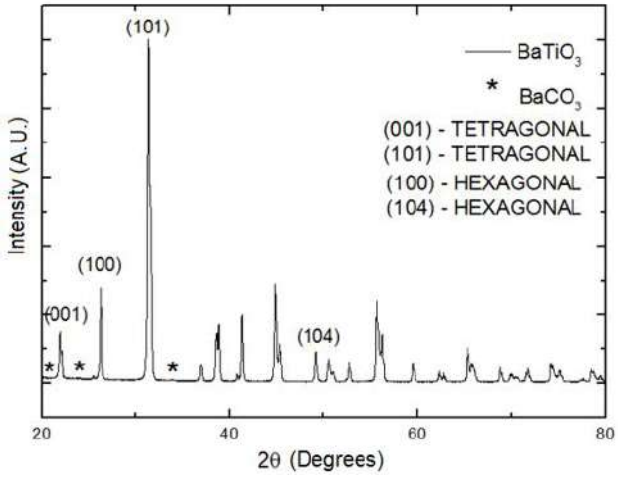

Fig. 9: Diffractogram of $BaTi_{(1-x)}Mn_xO_3$ calcined at 1200 ºC for x=0.05.

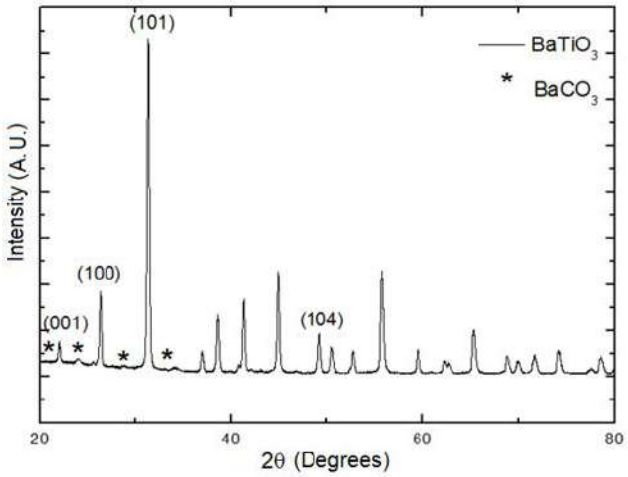

Fig. 10: Diffractogram of $BaTi_{(1-x)}Mn_xO_3$ calcined at 1200 ºC for x=0.1.

Tolerance factor analysis is given from ionic radius (Equation 8). For the structure to remain cubic, the tolerance factor must be between 0.95 < t < 1.0. Through the calculations of the tolerance factor for $BaTiO_3$ and $BaTi_{(1-x)}Mn_xO_3$ it is obtained that when the substitution of the Ti ion by Mn occurs the structure in no longer cubic, acquiring the property of ferroelectricity.

$$t = \frac{1}{\sqrt{2}} \frac{(R_A + R_O)}{(R_B + R_O)} \quad (8)$$

The ionic radius used to calculate the tolerance factor were Mn=0.067nm, 0=0.140nm, Ba=0.136nm, Ti=0.068nm [16]. For $BaTiO_3$ the tolerance factor has a value of 0.94 which is a value that is not within the range of a cubic structure, as it has a tetragonal structure.

The calculations were also performed for the compositions $BaTi_{(1-x)}Mn_xO_3$ obtaining a value of 0.94, ie, they also do not have a cubic structure having ferroelectricity.

Through the diffractograms we obtained the necessary data to find the lattice parameters "a" and "c" through Equation 4 (tetragonal symmetry) and Equation 5 (hexagonal symmetry). Figures 11 and 12 shows the lattice parameters for pure $BaTiO_3$ and $BaTi_{(1-x)}Mn_xO_3$ at a calcination temperature of 1200ºC both with tetragonal symmetry.

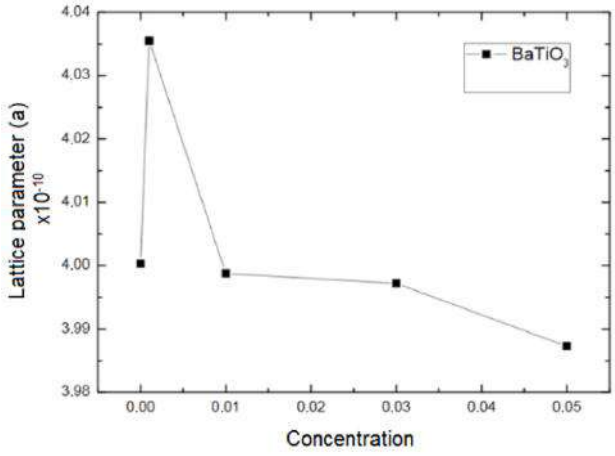

Fig. 11: Lattice Parameter "a" – Tetragonal Symmetry - calcined at 1200ºC.

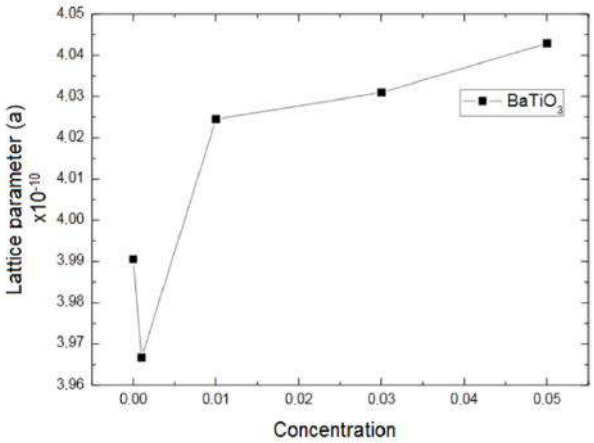

Fig. 12: Lattice Parameter "c" – Tetragonal Symmetry - calcined at 1200ºC.

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Through the analyzes performed on the samples it was possible to identify that the tetragonal phase was present up to a concentration of 5% Mn (x = 0.05), increasing to a 10% Mn concentration in $BaTi_{(1-x)}Mn_xO_3$ material causes the cell to stretching and tetragonal symmetry ceases to exist, and only hexagonal symmetry is present. In Figures 13 and 14 it is possible to identify that the presence of the hexagonal phase can be identified from the concentration of 3% Mn (x = 0.03), this concentration of Mn at which the cell starts to stretch.

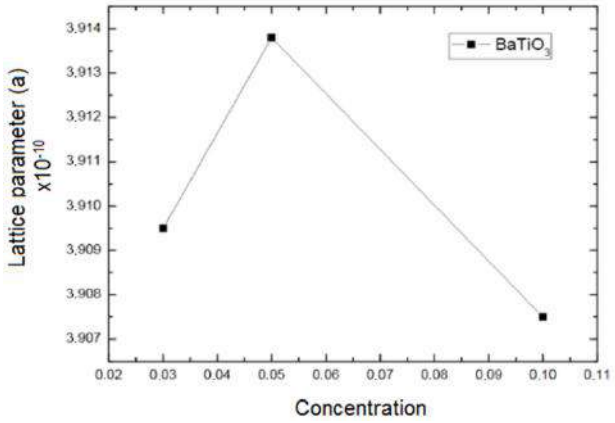

Fig. 13: Lattice Parameter "a" – Hexagonal Symmetry - calcined at 1200ºC.

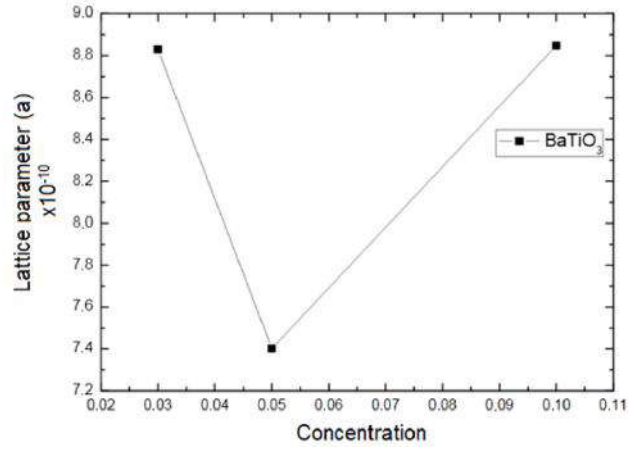

Fig. 14: Lattice Parameter "c" – Hexagonal Symmetry - calcined at 1200ºC.

From the results of the lattice parameters it was possible to notice an inverse increase in relation to the parameter "a" and "c" in the tetragonal symmetry, causing an increase in the c/a ratio, which is a favorable characteristic for the piezoelectric and ferroelectric properties. The change of lattice parameters occurs due to the substitution of Mn at the site occupied by Ti. Also, through the diffractograms and equations presented in this work, it was possible to calculate the theoretical densities of $BaTi_{(1-x)}Mn_xO_3$ samples for their respective concentrations. Results are presented in Table 2 and Figures 15 and 16.

Table 2 - Theoretical densities of calcined powders at 1200ºC of $BaTi_{(1-x)}Mn_xO_3$.

Substitution Dosage - Manganese	Phase	Theoretical density (g/cm³)
X=0.001	Tetragonal	5.9945
X=0.01	Tetragonal	6.0191
X=0.03	Tetragonal	6.0178
	Hexagonal	2.4967
X=0.05	Tetragonal	6.0337
	Hexagonal	2.4899
X=0.1	Hexagonal	2.5056

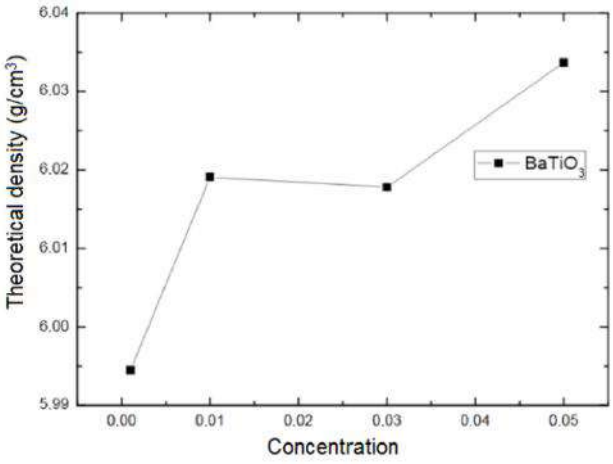

Fig. 15: Density relative to Mn dosage, Tetragonal phase.

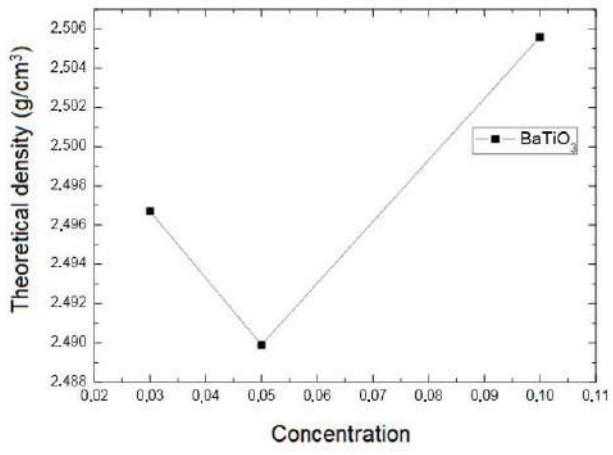

Fig. 16: Density relative to Mn dosage, Hexagonal phase.

The sample densities were measured for each concentration and since the powder from which of the samples were calcined at 1200 ºC, the theoretical density was 5.98402g/cm³ for the tetragonal structure and 2.4974g/cm³ for the hexagonal phase.

https://dx.doi.org/10.22161/ijaers.69.12 *ISSN: 2349-6495(P) | 2456-1908(O)*

Another result obtained in this work was the determination of the magnetic hysteresis curve in order to identify the presence of magnetism in the samples. The materials that presented such properties were those with concentration of 5% and 10% of Mn, with the highest magnetization value obtained for an applied magnetic field of 15000 Oe, the sample with the highest Mn concentration, ie x = 0.1, was ~ 0.05 emu / g, while for the sample of x = 0.05 the magnetization obtained was ~ 0.03 emu/g. For concentrations below 5% (x = 0.05) the results are not shown as the equipment was unable to measure.

As shown in Figure 17, the material analysis for x=0.05 showed low magnetization, not reaching saturation. The magnetic hysteresis curve shows an increase in magnetization as the applied field increases, generating for the highest applied field intensity 15000 Oe, the magnetization of ~ 0.03 emu/g, high values when compared to the literature. Rani et. al. (2015) was obtained for a 5000 Oe field, a magnetization of 0.006 emu / g, while in the present work, for an applied field of 5000 Oe, a magnetization of ~ 0.01 emu/g was obtained. The remaining magnetization for $BaTi_{(1-x)}Mn_xO_3$ with x=0.05 has values around 0.0006 emu/g. At 10% Mn concentration (x = 0.1), the remaining magnetization of $BaTi_{(1-x)}Mn_xO_3$ material has a higher value when compared to the 5% Mn concentration (x = 0.05) giving a value of ~ 0.001 emu/g.

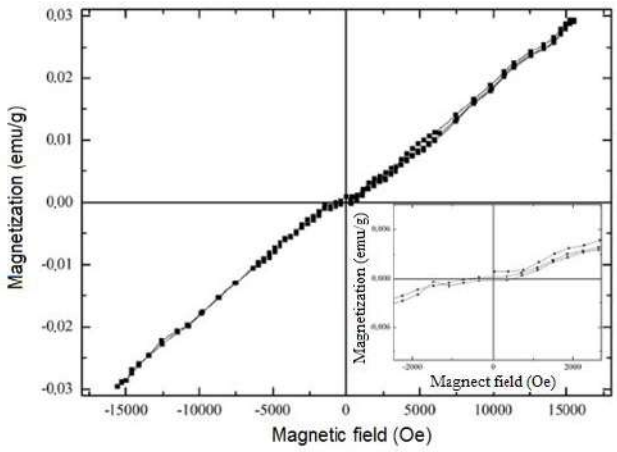

Fig. 17: Magnetic hysteresis measurements: $BaTi_{(1-x)}Mn_xO_3$ for the concentration of x=0.05

Figure 18 presents the analysis results for concentration of x = 0.1. In this material magnetization presents a better result than when compared to the lower Mn concentration material. For this material, the magnetization has a value of ~ 0.05 emu/g for an applied field of 15000 Oe. Rani et. al. (2015) presented for this same concentration and for an applied field of 5000 Oe a magnetization value of ~ 0.017 emu/g, while for this same field and concentration, the value obtained was ~ 0.019 emu/g.

The tetragonal to hexagonal phase transformation of the $BaTiO_3$ has been reported at high temperatures leading to high oxygen deficiency. Another considerable factor for the increase in oxygen vacancies is the increase in Mn concentration, having a greater amount of deficiency with a higher Mn concentration. Low substitution in $BaTi_{(1-x)}Mn_xO_3$ ceramics, oxygen vacancies are not high enough for complete transition from tetragonal to hexagonal phase. Induction of magnetism in $BaTi_{(1-x)}Mn_xO_3$ ceramics occurs due to the formation of oxygen vacancies and exchange interactions between different oxidation states of Mn [15]. Rani et. al. (2015) also state that the ferromagnetic order (FM) gradually increases with increasing concentration of ions Mn and with the change of oxidation state.

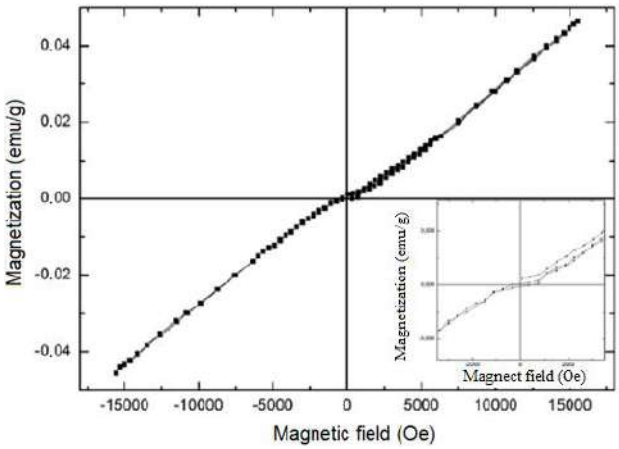

Fig. 18: Magnetic hysteresis measurements: $BaTi_{(1-x)}Mn_xO_3$ for the concentration of x = 0.1.

In the analyzes performed it was possible to verify low values for remaining magnetization, and it can be verified through magnetic hysteresis that there was a significant improvement in the remaining magnetization values with the increase of Mn concentration.

IV. CONCLUSION

Through the analyses of the diffractograms, it was possible to identify a change in the lattice parameters “a” and “c”. Analyzing the samples that showed tetragonal symmetry, it was observed that as the concentration of the replacement ion Mn increased, the lattice parameter “c” increased, while the parameter “a” decreased. In order to explain the alteration of the lattice parameters, the influence of the concentration of the Mn dopant with different oxidation states should be taken into account, being incorporated into the $BaTiO_3$ tetragonal and hexagonal systems.

https://dx.doi.org/10.22161/ijaers.69.12 *ISSN: 2349-6495(P) | 2456-1908(O)*

As the concentration of Mn increases, cell stretching occurs, influencing the transformation of tetragonal to hexagonal symmetry. The incorporation of Mn ions into $BaTiO_3$ tetragonal cells causes crystal structure disorder, so the variation of $Mn^{(+3)}$, $Mn^{(+4)}$ ions concentration in the tetragonal and hexagonal structure are responsible for these changes in the lattice parameters.

The substitution of the Mn ions occurs at the Ti site and is responsible for the variations of the lattice parameters. The interaction between different oxidation states of Mn may reduce or increase size depending on the ion to be replaced. When this substitution occurs between the ions of $Mn^{(+3)}$ and $Ti^{(+4)}$ the lattice parameters increase, while when the substitution is made by a smaller ionic radius, that is, $Mn^{(+4)}$ occurs reduction of lattice parameters. Thus, it is concluded that $Mn^{(+3)}$ is located in the tetragonal symmetry, because with the increase of $Mn^{(+3)}$ concentration, the increase of "c" occurs. While $Mn^{(+4)}$ is located in hexagonal symmetry, thus parameter "a" decreases with increasing doping concentration. Making sure that when Mn assumes the position of Ti, the cell stretches as the concentration increases.

The phase structural transition, parameter variation, temperature, particle size, impurities and defect density directly influence the properties of $BaTi_{(1-x)}Mn_xO_3$. The properties of the material are also completely dependent on the concentration of Mn, increasing the concentration of the substituent ion is also responsible for the change in grain size. As the concentration of Mn increases, the material grains become coupled and reduce in size. Noting that the micro-structural growth habit and its distributions are completely dependent on Mn concentrations, and the grain size is responsible for the mechanical properties of a polycrystalline material.

The substitution of Mn ions by Ti ions in $BaTiO_3$ generated magnetic properties, and through the magnetic hysteresis curve it was possible to identify that with increasing manganese concentration the magnetization intensity also increased. For materials with a small percentage of Mn substitution, it was not possible to obtain magnetic measurements, as they presented low magnetization.

A magnetoelectric multiferroic material originated, as it presented ferroelectric and magnetic properties with increasing doping ion concentration, which can generate applications where the same material can perform more than one task and thus generate a growing interest in these materials.

ACKNOWLEDGEMENTS

This work was supported by FAESO (Faculdade Estácio de Sá de Ourinhos), Complexo de Centrais de Apoio à Pesquisa (Comcap) and Grupo de Desenvolvimento de dispositivos Multiferróicos (GDDM) of Universidade Estadual de Maringá.

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https://dx.doi.org/10.22161/ijaers.69.13 ISSN: 2349-6495(P) | 2456-1908(O)

Holistic analysis of the Vehicle Routing Problem: an approach for GIS-T

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Abstract**—***Urban cargo transport movements, due to their characteristics and particularities, involve different dimensions and variables. As a result, it demands specific logistics costs, consisting of a relevant portion of the total business costs, being directly linked to the route taken by the vehicle fleet. In that way, it is necessary to define roadmaps for vehicles in order to minimize the total distance traveled, total cost and total elapsed time when supplying clients. With the development of hardware and software in the 90's, complex Vehicles Routing Problems (VRP's) (containing multiple clients and vehicles) started to being solved by iterative mathematical methods. Thus, this article aim to solve the VRP's of a garlic-based products fabricate company using a Geographic Information System for Transportation (GIS-T), performing comparative analysis with the current company operations and presenting alternative scenarios that may provide any cost reduction.*

Keywords**— Decision making support, Transportation System Planning, Balancing urban freight transport.**

I. INTRODUCTION

The contemporary market has indicated that for the survival of an organization, there is a need for prior planning of strategies to improve the management of its market share.

Reducing costs is a crucial point in a modern market strategy and, as a result, reducing waste, rework and especially logistics costs. This approach is cited by Christopher (2016) and Göpfert et al. (2016), which add the need for the organization to reinvest part of the balance obtained with these strategies, in other activities that may add greater value to the business. For Ivanov et al. (2017), the main bottleneck in logistics costs is transportation-related costs. For these authors, this explains the complexity surrounding transport operations considering different origins and destinations.

Within this context, Novaes (2016) highlights the importance of optimizing distribution routes due to their direct contribution to the increase in transportation costs. According to this author in the United States of America, the transportation matrix is more balanced than in other countries, logistics costs, including transportation, represent 59% of this matrix. In Brazil, besides the unbalance of transport matrix, in which the largest portion (60%) of cargo and goods are transported by road (ARAÚJO et al., 2014). According to Rodrigues et al. (2016), this type of problem should be treated as a Vehicle Routing Problem (VRP) and, from this, the generated alternatives should minimize transportation costs.

Corroborating this view, Wang et al. (2017) highlights that from the coming of modern technologies, it has been possible to provide innovations in VRP resolution. These authors further point out that current VRP models are different from those introduced by Dantzig and Ramser (1959), Clarke and Wright (1964), as they increasingly aim to incorporate real-life complexities such as collection time windows. and delivery, and demand information, which changes dynamically over time.

According to Laporte (1992), VRP's are a class of combinatorial optimization problems that allow optimizing vehicle routes and, in urban cases, their resolution associated with transportation planning provides better mobility. This optimization, according to Ribeiro et al. (2019), is considered significant because it represents a large part of the flow of vehicles for good distribution in cities. Earlier research demonstrating how vehicle routing optimization can lead to significant savings, which can be estimated between 5 and 30% by Hasle and Kloster (2007) or between 5 and 20% advocated by Toth and Vigo (2002), corroborate this view of Laporte (1992) and

https://dx.doi.org/10.22161/ijaers.69.13 *ISSN: 2349-6495(P) | 2456-1908(O)*

Ribeiro et al. (2019). However, route optimization in cities provides specific features that foster the development of new approaches.

Considering the contexts presented here, this paper presents an approach to VRP resolution, which can be parameterized for different situations and cases. Importantly, our goal is not just to provide a solution in light of the literature on the subject. In fact, we seek two additional scopes, namely: providing a broader view of city distribution research and thereby helping researchers better understand the practical motivations involved in vehicle routing and, identify major challenges in urban vehicle routing.

In addition to this introductory part, the work brings in the second section a brief literature review about distribution and transportation channels, emphasizing VRP as a challenge within the logistics area. Following, the third section presents the methodological approach used. Subsequently, the results of the application are presented. And finally, the conclusions and reflections on the main findings.

II. THEORETICAL REFERENCE

Logistics is a key element of competitive advantage, concerned with managing the physical flow of resources, starting at the source of supply and ending at the point of consumption. It can then be defined as a process that integrates, coordinates and controls the movement of resources such as humans, materials or services. Transportation management is an essential part of a logistics system, and the activity is responsible for the flows of raw material and finished product between links in the logistics chain (PRAJOGO et al., 2016).

Transport within a production unit can be seen as the most significant cost element when it comes to logistics costs. Economic variables such as high fuel prices, poor roads, high taxes, tolls, among other aspects, have a direct influence on the composition of logistics costs. Thus, organizations face important challenges related to the planning of logistics activities and the management of the corresponding costs, and at the same time need to offer more quality and speed to the consumer market. Thus, a well-structured logistics aims to minimize the costs of moving products in time (inventory) and space (transportation), and seek to contribute to the company achieve a greater scope of operation in the market and greater recipient or customer satisfaction (DONALD et al., 2014).

Among the essential decisions involving logistics, it is noteworthy that shipment routing, vehicle scheduling and freight consolidation are important variables for decision making, as they impact the total costs of logistics activities. One of the tools to assist managers in this activity is vehicle routing, which consists of defining itineraries to be traveled by vehicles serving a warehouse or distribution center. Within this context, cargo routing is the process of scheduling the distribution of cargo on delivery routes or routes, by cross-checking cargo volume or weight information, vehicle capacities and delivery locations in order to obtain the best result in terms of truck occupancy and delivery deadlines. In this sense, routing can be fixed route, in which the system distributes the loads to be transported by a previously stipulated route and characterized by the Postal Code and dynamic route numbers, where the best delivery route is suggested depending on the analysis of information about cargo to be transported, vehicle capacities, street, road and delivery information (BOTELHO et al., 2017).

Within this context, there is the Vehicle Routing Problem (VRP), which is defined as a problem designed to find optimal delivery or collection routes from one or several depots to a number of locations, whether cities or customers, while satisfying certain restrictions. VRP plays an important role in distribution and transportation logistics. And, a prerequisite for solving this problem is that customers are known in advance. In addition, the travel time between customers and the service times at each also need to be known (LEVIN, 2017).

Formally, the classic vehicle routing problem (VRP) is represented by a directed graph $G = (V, A)$, be for example a graph in which $V = \{1 \ldots n\}$ is a set of vertices representing cities with the depot located at vertex 1 A , is the set of arcs. With each bow $(i, j) i \neq j$ is associated with a nonnegative distance matrix $C = (c_{ij})$. If $c_{ij} = c_{ji}$ then the symmetric VRP and otherwise the problem is asymmetric. In some specific contexts, c_{ij} can be interpreted as a travel cost or as a travel time. When C is symmetrical, it is often convenient to replace A by a set E of undirected edges. Also, suppose there are m available depot-based vehicles where $m_L < m < m_U$. So, when $m_L = m_U$, m It is said to be fixed. And in the event of $m_L = 1$ e $m_U = n-1$, m It is said to be free. When m not fixed it often makes sense to associate a fixed cost f when using a vehicle.

From the point of view of complexity, according to Soysal et al. (2018), the classic VRP is known as NP-hard (Non-deterministic Polynomial-time hardness) as it

https://dx.doi.org/10.22161/ijaers.69.13 ISSN: 2349-6495(P) | 2456-1908(O)

generalizes the Traveling Salesman Problem (TSP) and the Bin Packing Problem (BPP). A relevant review of variants and mathematical formulations for the classic VRP can be found in Laporte (1992).

III. METHODOLOGICAL APPROACH

As a research unit was approached the optimization of the route used by a manufacturer and distributor of garlic products located in the city of São Mateus (Espírito Santo / Brazil). In this work it was considered exclusively the departure of the company with the cargo to be transported and its return after unloading at its stopping points.

Although the company studied has a large number of stopping points in the state of Espírito Santo and also in other states, the sample of this work consists exclusively of the points located in the city of São Mateus and, which have delivery route and known demands. Thus, considering that the regular service cycle ends within a week, the interval of the collected data will also correspond to this period.

Data collection was started from a documentary consultation about the routes of the studied company, in order to elucidate the routes to be performed and their characteristics (technical and geographical).

From this, the collected data were distributed and related to the variables of the mathematical model of VRP, namely: Number of vehicles belonging to the wholesale company; Battery capacity; Number and geographical location of customers in the north of Espírito Santo state and the warehouse; Total and each customer demand; Window of service time of each customer; Total size of the route traveled; Fuel consumption during the journey; and Other costs directly related to the route traveled.

The results obtained through the VRP solution were triangulated with the current ones employed by the company through a Geographic Information System for Transportation (GIS-T) - TransCAD version 6.0, which allowed for a route feasibility analysis, taking into account consideration the direction and direction of the flows of city traffic.

Thus, considering the geographical limitations and technical possibilities, three hypotheses were elaborated to guide the VRP study, based on the costs and the number of vehicles involved in the routing, to be implemented as VRP inputs. Thus, the first hypothesis considered the script currently adopted and which, according to the experience of drivers, is therefore not an optimal solution. In the second hypothesis, with the help of GIS-T where routing techniques were applied, the representation of the road network aimed to reduce the length of the routes. And finally, in the third hypothesis the result obtained with the optimization process should generate a set of routes that reduce the logistics costs related to the VRP of the studied company.

IV. RESULTS

The research unit used is a manufacturer and distributor of garlic products, which are subdivided as follows: fresh garlic in 200g and 300g packagings, minced (or garlic paste) and fried garlic with a monthly output of approximately 24 tonnes - if all product variations are added together. This production is distributed among the company's customers in São Mateus (restaurants and retail chains such as supermarkets, bakeries, butchers and grocery stores).

In the sector responsible for product distribution there are two employees: the driver (responsible for driving the company's truck) and the delivery assistant. It is important to note that by providing the delivery service, there is a fee charged by the company proportional to the quantity (mass) of product requested by the customer - which causes some to dispense with this service.

Thus, the intrinsic characteristics of the truck used in the deliveries were initially raised, namely: Brand: Mercedes Benz; Model: Acello; Year: 2008; Fuel Used: Diesel; Average fuel consumption: 5.5 km / l (kilometers per liter); Payload capacity: 5.5 tons; Tire change period: every 6 months (approximately 50,000 km); Oil change: From 15,000 to 15,000 km and, Box capacity used on delivery: Average 9.5 kg. This information was verified to indicate the possible expenses and the available transport capacity, to assist in the parameterization regarding the VRP model.

Deliveries are made every Wednesday in the afternoon, starting activities from 14h. This delivery time is used due to unavailability by some customers to receive cargo at alternative times (Restaurants: receiving unavailability period - 11h to 13h and Supermarkets: receiving unavailability period - 11h to 14h). On delivery days, the driver and aide with the help of some employees load the truck in the morning with each customer's requests - listed in a spreadsheet with their unit values and totals to be paid.

The company divides its customers into three groups according to the volume and cycles of each order; Group 1 consists of small buyers located in the city of São Mateus (restaurants, snack bars, butchers and industrial kitchens); Group 2 consists of all supermarkets and; Group 3 by supermarkets located in the region of Guriri Island - being an area located about 12 km away from the city center, was not understood in the scope of this work.

To obtain information on delivery routes, data collection was performed with the support of the driver and the assistant on the dates of 27/02/2019 and

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06/03/2019, with the first intended for Group 1 information and the second to Group 2. To quantify the values of each route, the follow-up of deliveries was made with a private car equipped with its odometer and a Global Positioning System (GPS), a time marker and a table containing information on: Order of attendance; Relationships of customers' fantasy names; Time of arrival at each customer's premises; Time of departure from each customer's premises; Quantity of product delivered in kilograms; and Distance from one customer and the next to be served.

Thus, after data collection, it was possible to obtain the following performance measures to be related between the routes used by the company and the results from GIS-T: Customer Travel Time i customer i + 1 (TVCi) - difference between customer arrival time i + 1 and customer departure time i; Total Travel Time (TVT) - The time the delivery truck spends traveling between customers. It is represented by the sum of TVCi's; Customer Service Time i (TSCi) - The time at which company employees perform customer delivery service i. It is calculated by subtracting the departure time from client i by the arrival time at the same client i. It is noteworthy that this time is not only composed of the act of delivery, but also verification of notes, possible receipts and other human factors - which makes it difficult to standardize service times taking into account the same customer; Total Service Time (TST) - Total time employees spend to perform deliveries. It is represented by the sum of the TSCi's; Total Distance Traveled (DTP) - represented by the sum of the distances traveled between customers; Total average speed (VMT) - ratio between DTP and TVT; Total Journey Time (TTP) - Subtraction between the time the truck arrives at the depot after making all deliveries by the time it begins its distribution journey. It can also be obtained by summing between TST and TVT and; Average fuel consumption (CMC) - obtained by dividing DTP by the average distance traveled by 1 liter of fuel per truck (5.5 km / l, according to the company).

It is noteworthy that the quantities of products and the addresses of each customer were obtained through the delivery notes individually. Thus, and after obtaining a georeferenced map (Figure 1) with a database of the city of São Mateus, a composite database was created.

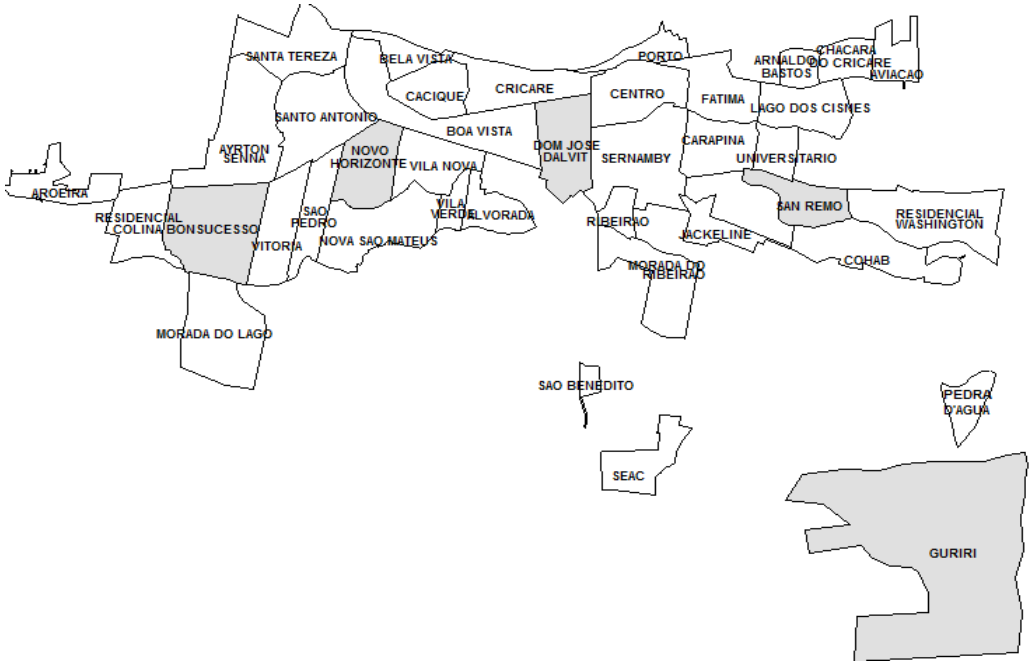

Fig. 1: Municipality of São Mateus

From this, a line layer was created to demarcate the city's streets and avenues (Figures 2 and 3), including intersections, road directions, speeds and street names for proper simulation. Then, the layers of points were elaborated, responsible for indicating the exact location of each client (costumer, in the TransCAD) as well as the location of the deposit. The database includes the following information: open_time; close_time; demand i; Fixed service time; and node_id i (node ID).

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Dataview1 - Customers

ID	Longitude	Latitude	NÚMERO	NAME	CAPACITY	OPEN_TIME	CLOSE_TIME	DEMAND	FIXED SERVICE TIME	TIME PER UNIT	NODE_ID
2	-87405813	30499049	2	RESTAURANTE O GA	--	1400	1700	14	6	0	1712
3	-87404614	30501193	3	RESTAURANTE ROBE	--	1400	1700	14	6	0	1454
4	-87404272	30501511	4	SAB. ROÇA, PALAD	--	1400	1700	51	47	0	1823
5	-87404290	30499213	5	RESTAURANTE AVEN	--	1400	1700	6	7	0	1565
6	-87402145	30500828	6	REST. WANTUIL	--	1400	1700	6	3	0	1481
7	-87401523	30501255	12	AÇOUGUE CARAN	--	1400	1700	10	6	0	1487
8	-87401506	30500914	8	CHURRASQUINO PRE	--	1400	1700	5	3	0	1496
9	-87400649	30501317	9	REST. ARAPONGAS	--	1400	1700	30	4	0	1508
10	-87400001	30501224	10	COZIVIP 1	--	1400	1700	75	7	0	1161
11	-87399829	30501185	11	COZIVIP 2	--	1400	1700	75	2	0	1530
12	-87399334	30499268	12	CEPE/ COZITA DA	--	1400	1700	10	7	0	1083
13	-87405435	30499284	13	PICANHA GRILL	--	1400	1700	14	4	0	831
14	-87407949	30500759	14	REST. BOROTO	--	1400	1700	8	6	0	872

Fig. 2: Route 1 customer care information (Group 1)

Dataview8 - PONTOS ROTA 2 :1

ID	Longitude	Latitude	NUMBER	NAME	CAPACITY	OPEN_TIME	CLOSE_TIME	DEMAND	FIXED SERVICE TIME	TIME PER UNIT	NODE_ID
2	-87408949	30499670	2	SUP. VILA NOVA	--	1400	1700	17	6	0	1773
3	-87412067	30500262	3	SUP. SANTO ANTON	--	1400	1700	175	18	0	393
4	-87412767	30500876	4	REDE MULTISHOW	--	1400	1700	23	7	0	348
5	-87404279	30501523	5	SUP. ANCHIETA	--	1400	1700	14	7	0	1824
6	-87404012	30501030	6	SUP. ZAMPIROLLI	--	1400	1700	15	8	0	1457
7	-87404037	30500130	7	SUP. CASAGRANDE	--	1400	1700	207	22	0	980
8	-87401938	30498919	8	SUP. RONDELLI	--	1400	1700	24	7	0	1798
9	-87401289	30501386	9	SUP. CARIOCA	--	1400	1700	11	6	0	1487

Fig. 3: Route 2 customer care information (Group 2)

Thus, after gathering this information (characterization of routes 1 and 2 and, from customers), these were ordered, creating a database for GIS-T operationalization. And following, The diagnosis was performed for the purpose of data collection, in which specific characteristics of the Group 1 clients' care route were observed (Wednesday, February 27, 1919), and the collected data were arranged in a layer (Figure 4), as well as, the route used in urban movements for these deliveries (Figure 5).

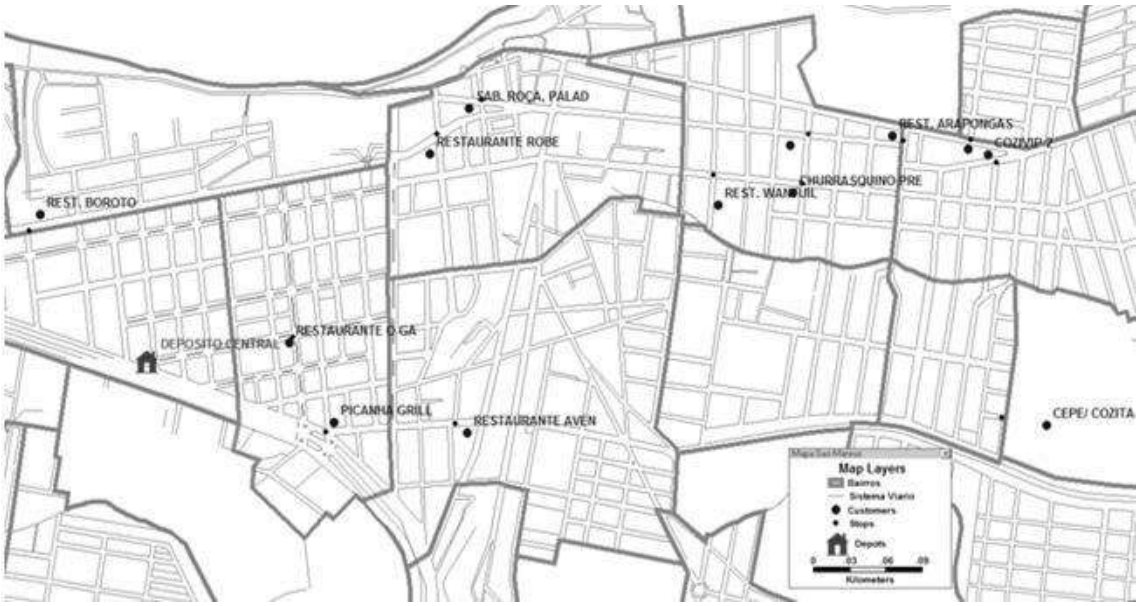

Fig. 4: Layer representing the geographic location of Group 1 customers

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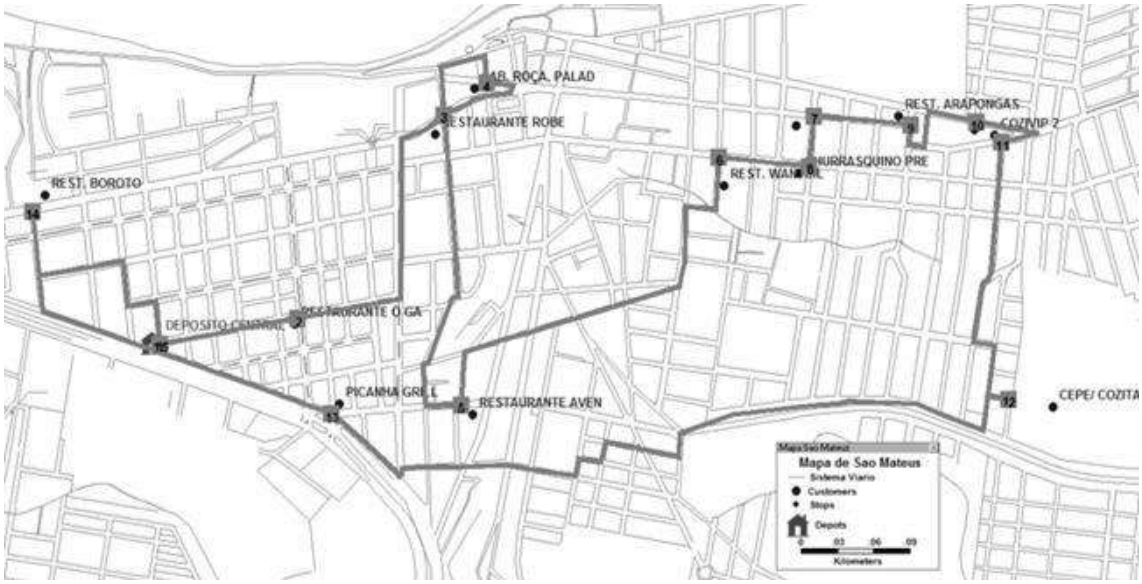

Fig. 5: Current route to service Group 1 customers

Completing the initial information diagnosis, data were collected that characterized the order fulfillment operations of each Group 1 customer by order of fulfillment. Thus, beacon parameters were raised that served as inputs in the resolution of the VRP, through GIS-T (TransCAD), being verified: the arrival and departure times of each delivery; the distances traveled between the stopping points and the quantities of products moved (Table 1).

Tab. 1:Group 1 route data compilation

Order	Client	Arrival Time (hours:minutes)	Departure time (hours:minutes)	Quantity (kg)	Distance (km)
1	DEPÓSITO	-	01:40 pm	-	-
2	Restaurante O Gauchão	01:42 pm	01:48 pm	14	0.4
3	Restaurante Robertinho	01:50 pm	01:56 pm	14	0.6
4	Sabor da Roça*	01:58 pm	-	8	0.4
5	Restaurante Paladar *	-	-	14	-
6	Restaurante Nó na Madeira*	-	-	6	-
7	Restaurante Atobá*	-	-	8	-
8	Lanchonete Arymas*	-	-	10	-
9	Restaurante Fogão a Lenha*	-	02:45 pm	5	-
10	Restaurante Avenida	02:49 pm	02:56 pm	6	1.0
11	Restaurante Wantuil	02:58 pm	03:01 pm	6	0.7
12	Açougue Caran	03:04 pm	03:10 pm	10	0.8

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13	Churrasquinho da Pretinha	03:11 pm	03:14 pm	5	0.2
14	Restaurante Arapongas	03:15 pm	03:19 pm	30	0.2
15	Cozivip 1	03:21 pm	03:28 pm	75	0.3
16	Cozivip 2	03:29 pm	03:31 pm	75	0.2
17	Restaurante do CEPE	03:34 pm	03:41 pm	10	0.8
18	Restaurante Picanha Grill	03:47 pm	03:51 pm	14	1.8
19	Restaurante Boroto	03:54 pm	04:00 pm	8	1.0
20	DEPÓSITO	04:03 pm	-	-	0.6

Although the company's initial listing indicated 20 customers to serve, the route used visited 18 customers. This is explained by the fact that some parts of the city have limited parking and time window for loading and unloading. Thus, in Table 1, The customers who are in this condition and who, the service was shared, are identified and highlighted by (*), due to a stoppage. Travel and service times of each customer visited are shown in Table 2.

Tab. 2: Service and travel times by Group 1 route customers

Order	Client	Travel time(hours:minutes)	Service time(hours:minutes)
1	Restaurante O Gauchão	00:02	00:06
2	Restaurante Robertinho	00:02	00:06
3	Sabor da Roça*	00:02	00:47
4	Restaurante Paladar*	-	-
5	Restaurante Nó na Madeira*	-	-
6	Restaurante Atobá*	-	-
7	Lanchonete Arymas*	-	-
8	Restaurante Fogão a Lenha*	-	-
9	Restaurante Avenida	00:04	00:07
10	Restaurante Wantuil	00:02	00:03
11	Açougue Caran	00:03	00:06
12	Churrasquinho da Pretinha	00:01	00:03
13	Restaurante Arapongas	00:01	00:04
14	Cozivip 1	00:02	00:07

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15	Cozivip 2	00:01	00:02
16	Restaurante do CEPE	00:03	00:07
17	Restaurante Picanha Grill	00:06	00:04
18	Restaurante Boroto	00:03	00:06
19	Restaurante O Gauchão	00:02	00:06

Then, after gathering the collected data, information on performance measures for the Group 1 route was generated, obtaining: Total Travel Time (TVT): 35 minutes; Total Service Time (TST): 1 hour and 48 minutes; Total Distance traveled (DTS): 9 km; Total Average Speed (VMT): 15.43 km / h; Total Travel Time (TTP): 2 hours and 23 minutes and; Average Fuel Consumption (MCC): 1.64 liters of diesel. As a result, when the VRP of this route was operationalized in TransCAD, the route optimization totaled 10.12 km, which differs from the distance obtained with the use of the vehicle odometer at the time of data collection. This gap between values, besides being related to the model of optimization, too, is linked to the fact that the vehicle odometer works with 100-meter multi-distance measurement and is reset after each delivery. Therefore, for the purpose of future comparisons, the data provided by GPS, which were entered in GIS-T will be effectively used in the result analysis.

Analogous to the procedures performed with the Group 1 service route, the Group 2 data collection operations were started. Thus, the clients of this other group were served on the following Wednesday (03/06/2019), and as Figure 6, as well as the routes used by the company (Figure 7).

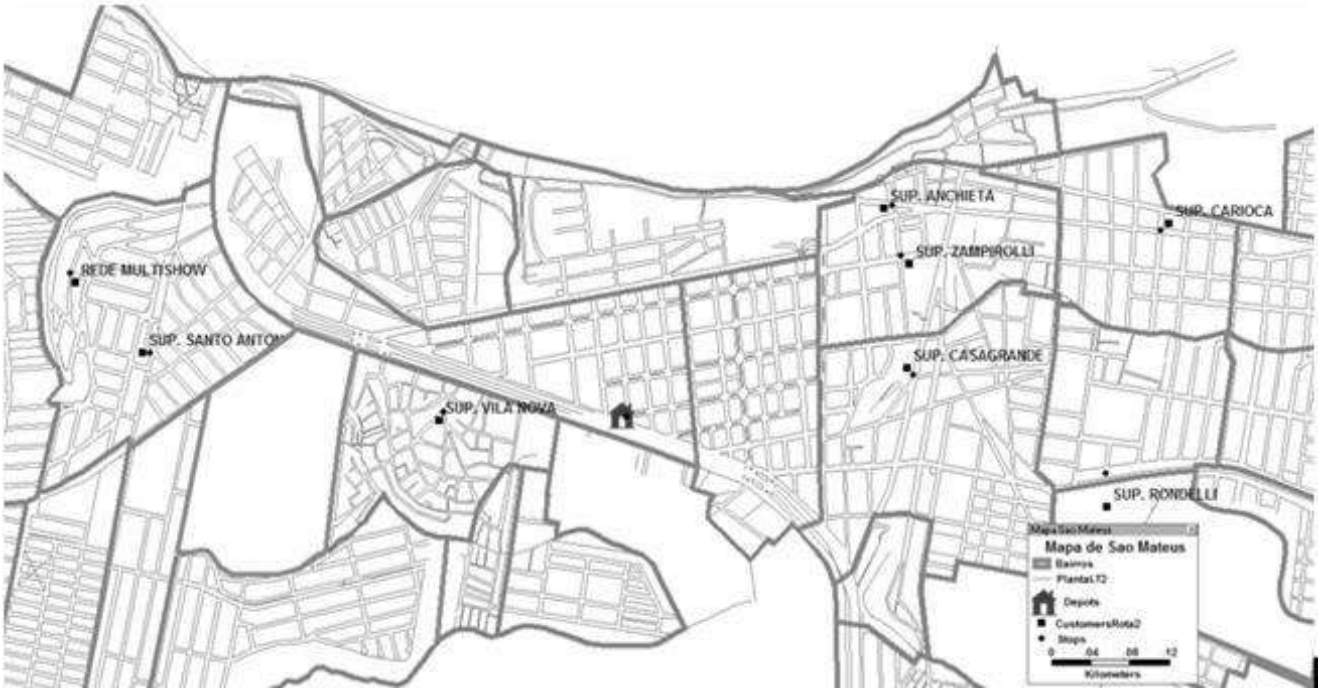

Fig. 6: Layer representing the geographical location of Group 2 customers

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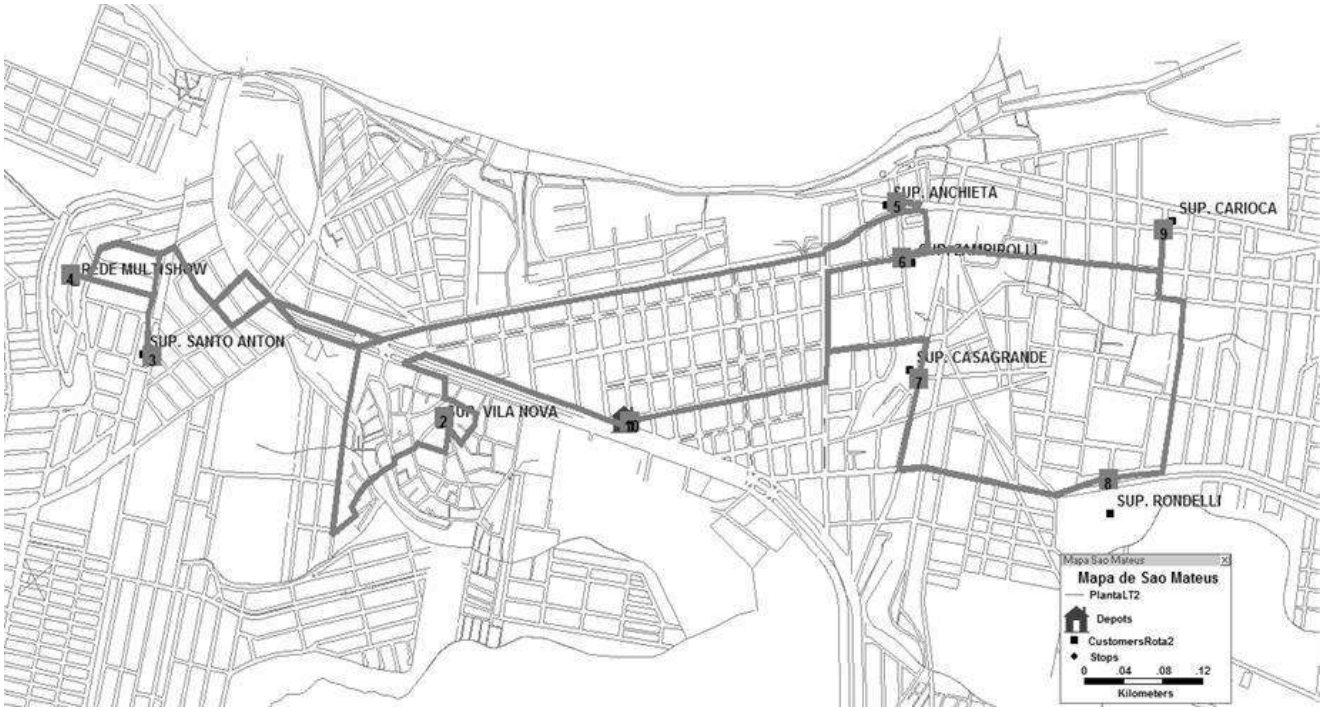

Fig. 7: Current route to service Group 2 customers

After these parameterizations the customers were sorted according to the service, arrival and departure times of each delivery, distances traveled between stopping points and quantities of products moved to Group 2 (Table 6 and 7).

Table 1: Group 2 route data compilation

Order	Client	Arrival Time (hours:minutes)	Departure time (hours:minutes)	Quantity (kg)	Distance (km)
1	DEPÓSITO	-	03:06 pm	-	-
2	SUP. VILA NOVA	03:11 pm	03:17 pm	17	1.3
3	SUP. STO ANTÔNIO	03:27 pm	03:45 pm	175	4
4	REDE MULTISHOW	03:52 pm	03:59 pm	23	1.2
5	SUP. ANCHIETA	04:07 pm	04:14 pm	14	3.8
6	SUP. ZAMPIROLLI	04:17 pm	04:25 pm	15	0.7
7	SUP. CASAGRANDE	04:28 pm	04:50 pm	207	0.5
8	SUP. RONDELLI	04:54 pm	05:01 pm	24	1,2
9	SUP. CARIOCA	05:05 pm	05:11 pm	11	2
10	DEPÓSITO	05:18 pm	-	-	2.3

Table 2: Service and travel times by Group 2 route customers

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Order	Client	Travel time (hours:minutes)	Service time (hours:minutes)
2	SUP. VILA NOVA	00:05	00:06
3	SUP. STO ANTÔNIO	00:10	00:18
4	REDE MULTISHOW	00:07	00:07
5	SUP. ANCHIETA	00:08	00:07
6	SUP. ZAMPIROLLI	00:03	00:08
7	SUP. CASAGRANDE	00:03	00:22
8	SUP. RONDELLI	00:04	00:07
9	SUP. CARIOCA	00:04	00:06
10	DEPÓSITO	00:07	-

Similar to previous procedures, after data collection, it was possible to obtain the following performance measures to be related between the routes used by the company and the results from GIS-T: Total Travel Time: 51 minutes; Total Service Time: 1 hour and 21 minutes; Total Distance traveled: 17 km; Total Travel Time: 2 hours and 12 minutes and; Average Fuel Consumption: 3.09 liters of diesel.

Thus, after compiling all the information, GIS-T, when solving the VRP for the Group 2 route, obtained a total distance traveled of 13.22 km, which differs from the total recorded by the odometer which is 17 km.

After obtaining the parameters of both groups, the generation of routes was performed based on the resolution to VRP by GIS-T. However, in order for the VRP to be solved by TransCAD, in addition to information from the customer database, warehouse and road system, it was also necessary to elucidate other elements that helped in the optimization of routes, such as: minimum paths between all network node pairs (client and depot).

TransCAD uses the layer that represents the road system to obtain the distances, however, this layer has associated with it a layer of points, called intersections (GUERREIRO et al., 2018). And so, according to these authors, at each intersection between two segments (street or avenues), a new point in the intersection layer is generated with a unique ID (ID).

From this, it was initially necessary to create a relationship between the intersection, customer and warehouse layers, obtained by the NODE_ID field present in the georeferenced database of these last two layers. This field is assigned the ID code of the intersection layer s closest to the customer or warehouse being analyzed. A distance matrix is generated by TransCAD, which refers to the relationship between customers and the warehouse for Group 1 (Figure 8).

Matrix4 - VRP Time Matrix File (Time)

	831	857	872	1083	1161	1454	1481	1487	1496	1508	1530	1565	1712	1823
831	0.00	0.41	1.14	2.09	2.86	1.78	1.65	2.16	1.90	2.52	2.64	0.35	0.50	1.84
857	1.41	0.00	0.82	3.50	4.28	1.63	3.07	3.58	3.31	3.93	4.05	1.77	0.76	2.00
872	2.07	1.10	0.00	4.16	4.23	1.15	3.02	3.48	3.27	3.89	4.01	2.42	1.48	1.51
1083	2.39	2.81	3.54	0.00	1.90	3.00	2.07	2.08	1.82	2.09	1.53	2.37	2.90	2.99
1161	2.94	3.35	3.23	1.90	0.00	2.36	1.22	0.97	0.97	0.44	0.55	2.70	3.07	2.34
1454	1.79	1.71	1.49	3.42	3.08	0.00	1.87	2.33	2.12	2.74	2.86	1.68	1.34	0.36
1481	1.72	2.13	2.01	2.07	1.21	1.14	0.00	0.51	0.25	0.87	0.99	1.49	1.85	1.12
1487	2.23	2.64	2.52	2.08	0.99	1.65	0.51	0.00	0.26	0.53	1.00	2.00	2.36	1.63
1496	1.97	2.38	2.26	1.82	0.96	1.39	0.25	0.26	0.00	0.62	0.74	1.73	2.10	1.37
1508	2.50	2.91	2.79	1.83	0.65	1.92	0.78	0.53	0.53	0.00	0.61	2.26	2.63	1.90
1530	2.71	3.12	3.00	1.53	0.55	2.13	0.99	1.00	0.74	0.78	0.00	2.47	2.84	2.11
1565	0.63	1.05	1.77	1.74	2.51	1.51	1.30	1.81	1.55	2.17	2.29	0.00	1.14	1.49
1712	0.66	0.76	1.50	2.74	3.52	1.25	2.31	2.82	2.55	3.17	3.29	1.01	0.00	1.61
1823	2.22	2.15	1.93	3.80	2.95	0.85	1.74	2.20	1.98	2.60	2.73	2.11	1.77	0.00

Fig. 8: Minimum path matrix between customers and warehouse

By obtaining the minimum path matrix and the previously obtained data, a simulation was performed and an optimized route was obtained from these parameters (Figure 9). Sequentially, the arrival and departure times,

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distances traveled, each customer's demand, total time and total distance traveled on the generated route, and order of service (Figures 10 and 11).

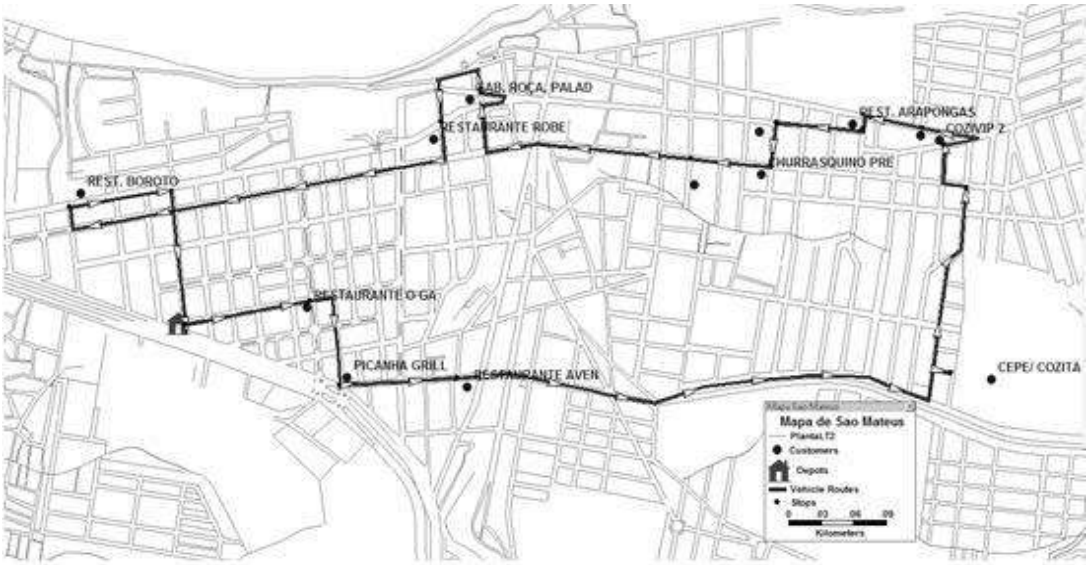

Fig. 9: Graphical representation of the optimized route from VRP to Group 1 customers

Dataview4 - Stops

ID	Route_ID	Milepost	STOP_ID	Route	[Veh. Type]	Stop	Name	Node	Sequence	[Open Time]
1	1	0.000000	1	1	1	1	DEPOSITO CENTRAL	857	0	1400
2	1	0.115141	2	1	1	2	RESTAURANTE O GA	1712	1	1400
3	1	0.214520	3	1	1	13	PICANHA GRILL	831	2	1400
4	1	0.321150	4	1	1	5	RESTAURANTE AVEN	1565	3	1400
5	1	0.803243	5	1	1	12	CEPE/ COZITA DA	1083	4	1400
6	1	1.046268	6	1	1	11	COZIVIP 2	1530	5	1400
7	1	1.129126	7	1	1	10	COZIVIP 1	1161	6	1400
8	1	1.196843	8	1	1	9	REST. ARAPONGAS	1508	7	1400
9	1	1.276354	9	1	1	7	AÇOUGUE CARAN	1487	8	1400
10	1	1.316329	10	1	1	8	CHURRASQUINO PRE	1496	9	1400
11	1	1.390715	11	1	1	6	REST. WANTUIL	1481	10	1400
12	1	1.666686	12	1	1	4	SAB. ROÇA, PALAD	1823	11	1400
13	1	1.764568	13	1	1	3	RESTAURANTE ROBE	1454	12	1400
14	1	2.163206	14	1	1	14	REST. BOROTO	872	13	1400
15	1	2.377135	15	1	1	1	DEPOSITO CENTRAL	857	14	1400

Fig. 10: Ordered sequencing from VRP resolution

ResRota1 - Bloco de notas

Arquivo Editar Formatar Exibir Ajuda

Itinerary Report

Route # : 1 Tot Time: 1:59 Capacity : 5500.0
Veh. Type: 1 Tot Dist: 7.9 Depart Load: 318.0

No.	Name	Arrival-Depart	Dist	Delivery
	DEPOSITO CENTRAL	2:00pm		
1	RESTAURANTE O GA	2:01pm- 2:07pm	0.33	14.0
2	PICANHA GRILL	2:07pm- 2:11pm	0,3	14.0
3	RESTAURANTE AVEN	2:12pm- 2:19pm	0,3	6.0
4	CEPE/ COZITA DA	2:21pm- 2:28pm	1.3	10.0
5	COZIVIP 2	2:29pm- 2:31pm	0.7	75.0
6	COZIVIP 1	2:32pm- 2:39pm	0.0	75.0
7	REST. ARAPONGAS	2:39pm- 2:43pm	0.0	30.0
8	AÇOUGUE CARAN	2:44pm- 2:50pm	0.0	10.0
9	CHURRASQUINO PRE	2:50pm- 2:53pm	0.0	5.0
10	REST. WANTUIL	2:53pm- 2:56pm	0.0	6.0
11	SAB. ROÇA, PALAD	2:57pm- 3:44pm	0.7	51.0
12	RESTAURANTE ROBE	3:45pm- 3:51pm	0.3	14.0
13	REST. BOROTO	3:52pm- 3:58pm	1.3	8.0
END	DEPOSITO CENTRAL	3:59pm	0.7	
Total			7.9	318.0

Fig. 11: GIS-T operationalization scheduling for Group 1 customers

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Following, besides the information obtained in the generated route report, it was possible to obtain performance meters which are: Total Travel Time (TVT): 11 minutes; Total Service Time (TST): 1 hour and 48 minutes; Total Average Speed (VMT): 43.09 km / h and; Average Fuel Consumption (MCC): 1.44 liters of diesel.

Thus, from this, the data regarding the travel times between customers were entered in the layer of the "SM Road System" layer, as well as the speeds with which the truck travels through each road of São Mateus (Figure 12), which take into account the maximum speed allowed on each lane, as well as factors such as traffic and truck weight. Thus, it was possible for GIS-T to analyze the VRP and even point arrival times at each point (customers and warehouse).

Dataview1 - Sistema Viario Sao M

ID	Length	Dir	Nome	Speed	[Time (min)]
521	0.01	0		30	0.06
1487	0.02	1	R JOAO EVANGELISTA MONTEIRO LOBATO	60	0.06
1138	0.02	-1	AV JOSE TOZZI	60	0.06
425	0.01	0		30	0.06
1134	0.02	-1	AV JOSE TOZZI	60	0.06
1811	0.01	0		30	0.06
221	0.01	0		30	0.06
1128	0.02	1	AV JOAO XXIII	60	0.06
472	0.01	0		30	0.05
1338	0.02	0	AV JOSE TOZZI	60	0.05
1270	0.02	-1	AV JOSE TOZZI	60	0.05
1832	0.01	0		30	0.05
1328	0.02	0	AV JOSE TOZZI	60	0.05
1023	0.01	0		30	0.05

Fig. 12: Parameterization of the Road System layer in the roads under study.

Similar to the procedures for obtaining Group 1 routing, the analyzes performed to obtain the Group 2 route continued using the same assumptions. Following these assumptions, the Group 2 customer movement and attendance route was generated (Figures 13, 14 and 15).

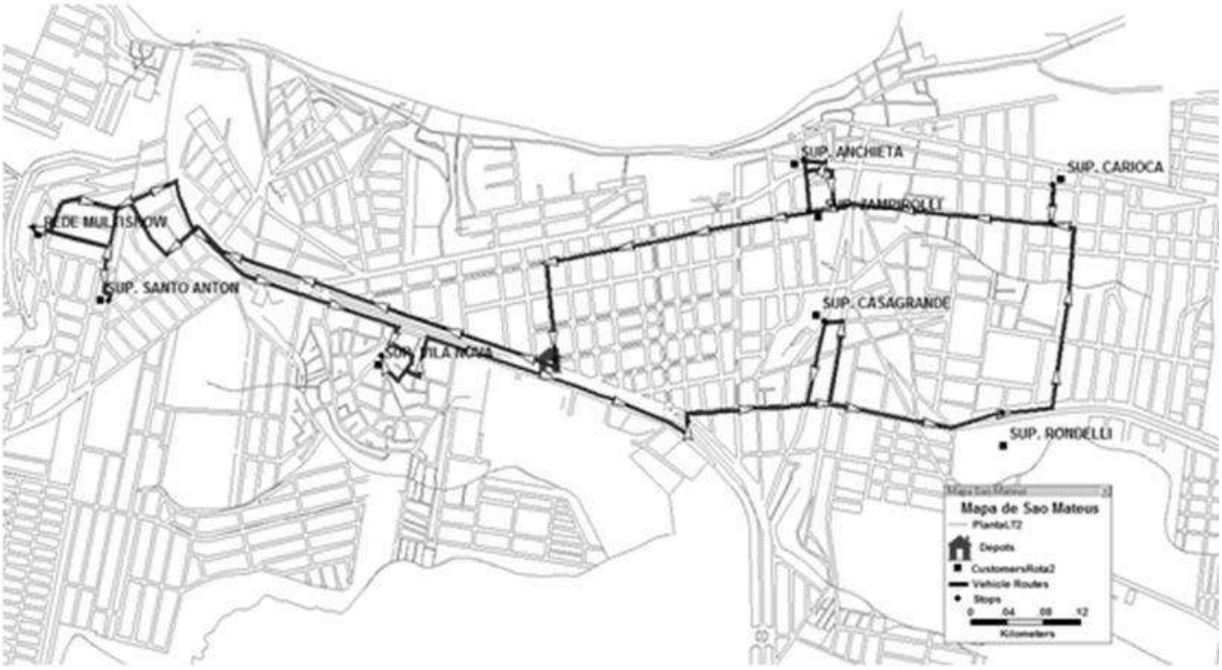

Fig. 13: Route generated to move and serve Group 2 customers

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Dataview4 - Stops

ID	Route_ID	Milepost	STOP_ID	Route	[Veh. Type]	Stop	Name	Node	Sequence	[Open Time]
1	1	0.000000	1	1	1	1	DEPOSITO CENTRAL	857	0	1400
2	1	0.650076	2	1	1	3	SUP. SANTO ANTON	393	1	1400
3	1	0.793942	3	1	1	4	REDE MULTISHOW	1663	2	1400
4	1	1.384142	4	1	1	2	SUP. VILA NOVA	1773	3	1400
5	1	2.065919	5	1	1	7	SUP. CASAGRANDE	980	4	1400
6	1	2.369740	6	1	1	8	SUP. RONDELLI	1052	5	1400
7	1	2.676370	7	1	1	9	SUP. CARIOCA	1487	6	1400
8	1	2.977479	8	1	1	6	SUP. ZAMPIROLLI	1457	7	1400
9	1	3.066702	9	1	1	5	SUP. ANCHIETA	1823	8	1400
10	1	3.558987	10	1	1	1	DEPOSITO CENTRAL	857	9	1400

Fig. 14: Orderly sequencing from VRP resolution (Group 2 clients)

ResRota2 - Bloco de notas

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```
                        Itinerary Report

Route #  : 1              Tot Time: 1:36        Capacity  : 5500.0
Veh. Type: 1              Tot Dist: 11.9         Depart Load: 486.0

No.   Name                          Arrival-Depart      Dist    Delivery
-------------------------------------------------------------------------
      DEPOSITO CENTRAL                      2:00pm
    1 SUP. SANTO ANTON            2:03pm- 2:21pm       2.0     175.0
    2 REDE MULTISHOW              2:22pm- 2:29pm       0.3      23.0
    3 SUP. VILA NOVA              2:31pm- 2:37pm       1.6      17.0
    4 SUP. CASAGRANDE             2:40pm- 3:02pm       2.0     207.0
    5 SUP. RONDELLI               3:03pm- 3:10pm       1.0      24.0
    6 SUP. CARIOCA                3:11pm- 3:17pm       1.0      11.0
    7 SUP. ZAMPIROLLI             3:19pm- 3:27pm       1.0      15.0
    8 SUP. ANCHIETA               3:27pm- 3:34pm       0.0      14.0
 END  DEPOSITO CENTRAL            3:36pm               1.3
                                                     ------------------
Total                                                11.9     486.0
```

Fig. 15: Programming of GIS-T-generated operation for Group 2 customers

Similarly obtaining results from Group 1, in the case of Group 2 clients, it was also possible to observe performance indicators, as follows: Total Travel Time (TVT): 15 minutes; Total Average Speed (VMT): 47.6 km / h and; Average Fuel Consumption (MCC): 2.16 liters of diesel.

By triangulating the data obtained through GIS-T (TransCAD) and the data obtained by the company's current routes, it was possible to verify that the methodology used in this work was efficient in reducing the distances to be traveled.

The final results suggest that there was a 22.7% reduction in the total route 1 route, something that Therefore, it also reduces costs related to variables such as fuel, total travel time and total travel time, and other vehicle-related costs such as maintenance. Regarding Route 2, although performance optimization did not reach the same level, fuel consumption was reduced by 10%, total travel time minimized by 27% and total travel time decreased by 70% (Table 8).

Table 8: GIS-T Results Analysis Compilation

Performance Measure	**Route 1 Company**	**Route 1 TransCAD**	**Route 2 Company**	**Route 2 TransCAD**
Total travel time (min)	35	11	51	15
Total average speed (km / h)	17.25	43.09	15.55	47.6
Total travel time (min)	143	119	132	96

https://dx.doi.org/10.22161/ijaers.69.13 ISSN: 2349-6495(P) | 2456-1908(O)

Performance Measure	Route 1 Company	Route 1 TransCAD	Route 2 Company	Route 2 TransCAD
Total distance traveled (km)	10.22	7.9	13.22	11.9
Average fuel consumption (liters)	1.9	1.44	2.4	2.16

Based on this information (Table 8), it can be seen that the route changes suggested by TransCAD from a georeferenced map and properly characterized, it has been able to generate an optimized route, which serves all customers, including minimizing transport costs and distance traveled.

To this end, scenarios were created that met the needs and prerogatives of the customers to be met. Thus, these customers were separated into two groups, in order to contemplate deliveries on different days. Although the company has a truck to handle delivery movements, its capacity can be considered relatively high from the point of view of meeting total order demand. For this reason, in this paper it was considered plausible to verify if the purchase of smaller vehicles can minimize transportation costs for the organization.

Thus, based on these assumptions, the VRP was analyzed using GIS-T, using two scenarios, one using the company's current vehicle (truck) and the other using two pickup trucks.

Scenario one considered a single route, which after specifying the geographical location of the two customer groups on a previously established route, was analyzed using TransCAD (Figure 16). Subsequently, delivery routes were defined and, by entering this data, it was possible to visualize in GIS-T the times and costs that involve the simulated route of scenario 1.

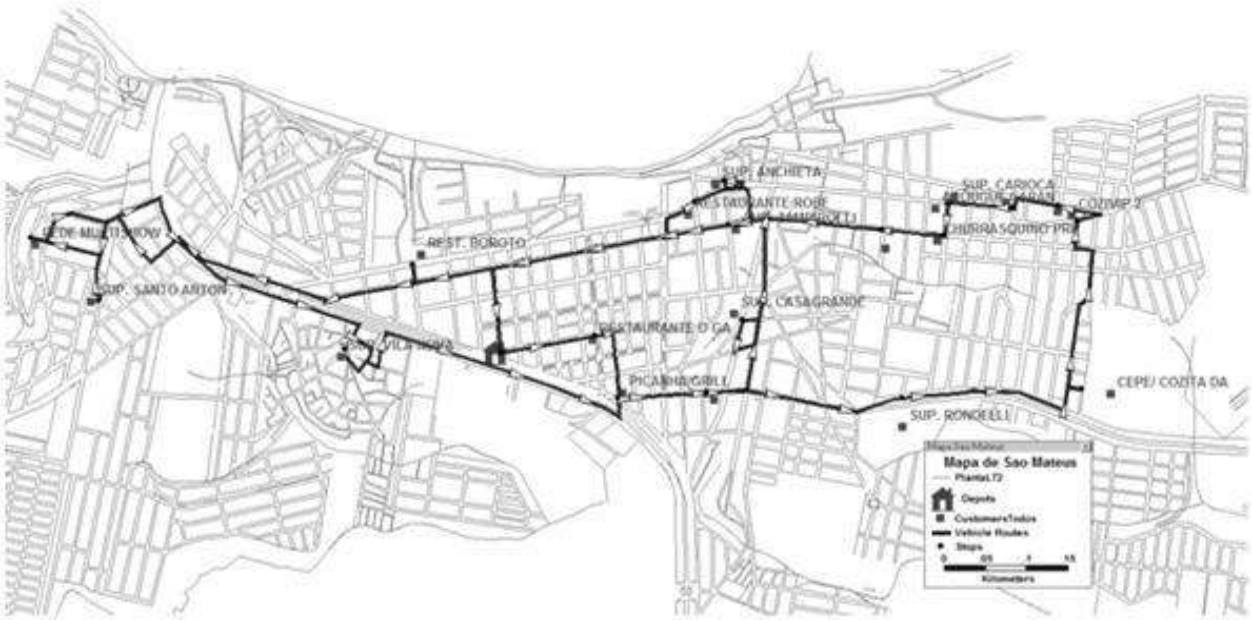

Fig. 16: Route Layer for scenario 1 obtained by GIS-T

Thus, the simulations performed for scenario 1, indicated a total travel time is 25 minutes; total service time of 3h06; average total speed of 38.88 km / h; and average fuel consumption of 2.9 liters of diesel. Numbers that, according to Min (1989) are considered excessive when using a truck on a route that involves urban movements. For Mahmoudi and Zhou (2016) deliveries involving medium and high unit volumes, deliveries by pickup trucks should be operationalized. These authors highlight not only better mobility issues with respect to traditional trucks, but also time and cost savings associated with their use.

Continuing with the analyzes, a new single-route simulation, scenario 2, was designed using two pickup trucks and a unique group of customers. This choice was due to the indication by Mahmoudi and Zhou (2016) to optimize cargo movement in urban areas. This indication was adopted, although the payload capacity of each pickup truck is 8 times lower than the company's truck capacity, however, having a better effectiveness pointed out by these

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authors. Due to the total demand to be moved, it was decided to use at least two pickup trucks to perform a single route (Figure 17).

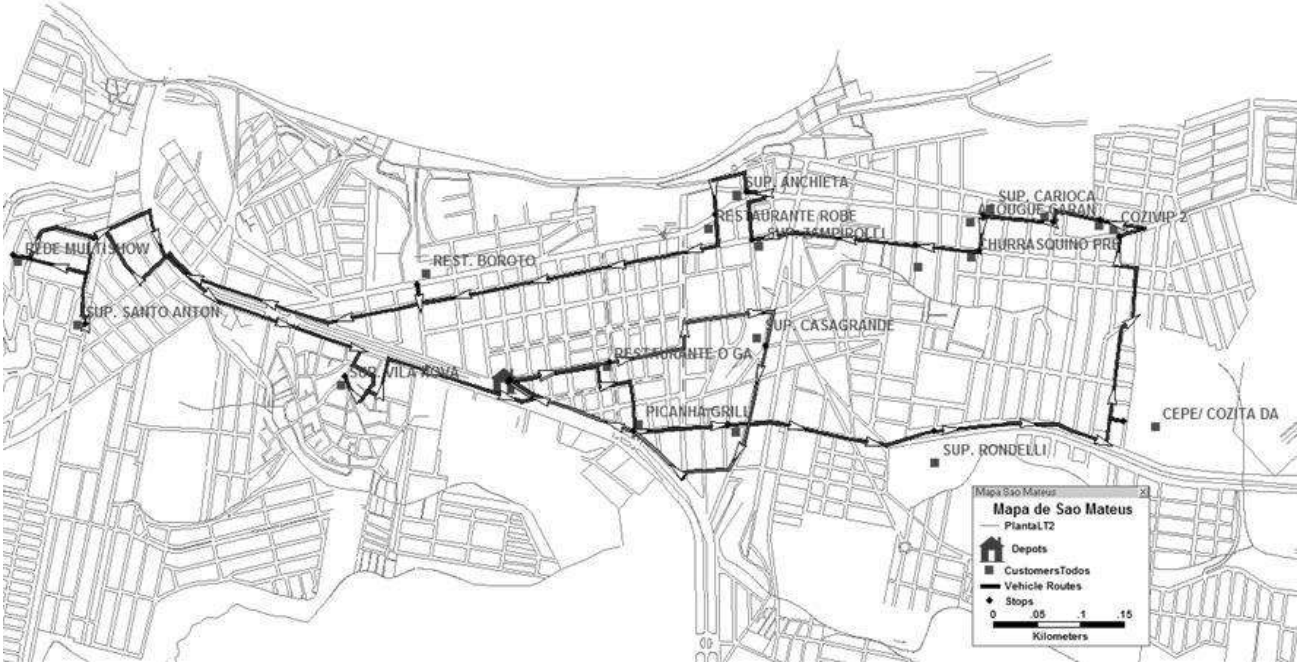

Fig. 17: Route Layer for scenario 2 obtained by GIS-T

Thus, after simulating scenario 2 and verifying the fulfillment of delivery orders, the following results were obtained: Total travel time: vehicle 1 - 21 minutes and vehicle 2: 4 minutes; Total service time: vehicle 1: 2h34 and vehicle 2: 32 minutes and; Total average velocity: vehicle 1: 35.4 km / h and vehicle 2: 39 km / h (Table 9).

Table 9: Arrangement of the various performances between the generated scenarios (current route and optimized route)

Performance Measure	Routes Company	Routes TransCAD	Scenario 1* Route (Diesel)	Scenario2 Routes (Alcohol)*	Scenario 2Routes (Gasoline)*
DTP (km)	23.34	19.8	16.2	15	15
CMC (liters)	4.24	3.6	2.95	1.45	1.02
Cost (USD)	2.37	2.01	1.65	0.92	0.74

** Average fuel prices: Diesel (0.92 USD); Alcohol (0.95 USD) and Gasoline (1.12 USD).*

Thus, when comparing the results of the VRP simulations of scenarios 1 and 2, it was identified that the variables are not directly influenced by the speed defined in the stretches along the route, in this case, the distances traveled and the average fuel expenditure. It is even possible to identify that the route defined by the company is the most financially expensive for the organization (Table 9), indicating, therefore, a need to review the operational and handling procedures related to deliveries. In addition, it is possible to verify that both scenarios are viable and that scenario 1 reduces costs by 30.6% and scenario 2 by approximately 68.6% if fueled by gasoline and 61.3% if fueled by ethanol.

VII. CONCLUSION

Optimizing costs and operations is critical when a company seeks market leadership. Actions such as vehicle routing can reduce transportation-related costs, the largest share of logistics costs. In this work it was possible to verify the reduction of fuel costs by optimizing the routes - reducing the length of the routes and therefore minimizing oil changes, hours worked, maintenance, vehicle change, etc., resulting in optimization of routes to the organization.

https://dx.doi.org/10.22161/ijaers.69.13 *ISSN: 2349-6495(P) | 2456-1908(O)*

Using TransCAD for VRP resolution enabled a reduction of 22.7% and 10% in reducing the length of routes for clients 1 and 2. Scenario simulation was also efficient, allowing to explore better solutions within the possible realities to be faced. for the company. However, some limitations should be taken into account in data analysis, such as the speed on city roads that varies according to traffic and the condition of routes and traffic lights.

The significance, implication and practical contributions of this work can be attributed to the proposed approach, which allows an application to various types of problems with different structures and vehicles. Second, this approach enriches the VRP literature in specific contexts. And, lastly, this work incites research directions regarding the development of approaches and optimization methods to deal with generalized submodels.

As a suggestion for future work, we recommend updating the georeferenced database with more detailed information regarding the average velocity in its various occurrences, as well as the inclusion of times in the semaphorized intersections.

ACKNOWLEDGEMENTS

We thank the Operations Research Laboratory, Logistics and Transport (POLT) of the Federal University of Espírito Santo (UFES)/ University Center North of the Espírito Santo (CEUNES) by the academic and technical support in the design and development of this work.

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https://dx.doi.org/10.22161/ijaers.69.14 *ISSN: 2349-6495(P) | 2456-1908(O)*

Evaluation on the risk of contamination by mercury and classification of areas at foz of river Tapajós, Pará, Brazil.

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Abstract *— Geostatistics is a tool that, in the last years, has been emphasizing in the analysis of spatial data in several areas, especially in the environmental sciences, since it is a technique that presents advantages in relation to other methods of spatial interpolation, mainly, by the possibility of analysis of data in small quantity, informing the errors of estimates and consideration of the anisotropy. In this work, mercury maps were elaborated from spatially distributed data, using Geostatistics to infer results for the location and risk of contamination of this metal along the mouth of the Tapajós River, Santarém-PA. Mercury contamination risk or probability maps were also constructed, which enabled the classification and quantification of the areas contaminated by this metal for several levels of confidence in and around the mouth of the Tapajós River. The methodological procedures will include the use of the "R" program to quantify mercury concentrations in the study area and to map the spatial distribution of these concentrations. To determine the total mercury in the samples, they were submitted to acid digestion and determinations of Hg performed by Atomic Absorption Spectrophotometry with cold steam generation at the Central Laboratory of the State of Pará. Two campaigns were carried out: in July and December 2014, with 37 and 45 sampling points in each one. The results point to a possible contamination of the area in some points, presenting indices above the one recommended by resolution n. 357/2005 of CONAMA.*

Keywords— *Geostatistics. Mercury contamination. Rio Tapajós. Santarém.*

I. INTRODUCTION

Geostatistics deals with simple but important questions ranging from spatial interpolation and quantification of uncertainty to variables that have spatial continuity that can be measured anywhere in the area / region / zone under study and is based on traditional statistical concepts. It is based on the Theory of Regionalized Variables, initially formulated by Matheron (1960), based on practical studies developed for estimates of mineral reserves by mining engineer D. Krige and H.S. Sichel, in the calculation of reserves in the gold mines of South Africa in the 1950s (CAMARGO, 2002). Nowadays, Geostatistics is applied in many fields, from earth and atmosphere sciences, agriculture, soil science and hydrology, environmental studies and, more recently, epidemiology.

It is the 60th International Congress of Geostatistics held in April 2000 in South Africa, where the work of Matheron and Sichel was highlighted, as well as the extraordinary development and diffusion of the use of computers and programs aimed at these areas that have fostered a rapid development of Geostatistics. It was during this period that regression estimates were used for mineral reserve blocks for the first time (CAMARGO, 2002). In the 1960s, Matheron made this technique known as kriging and established the first global geostatistical model for reserve recovery estimation and many fundamental concepts in Geostatistics and valid to this day. From there, this knowledge was disseminated throughout the world following the French formation (JOURNEL, 1984; KRIGE, 2000; QUEIROZ, 2003).

https://dx.doi.org/10.22161/ijaers.69.14 *ISSN: 2349-6495(P) | 2456-1908(O)*

In the 1970s, there was great growth not only of the geostatistical community but also of new models. In the following decade a rapid expansion of computers and softwares occurred, especially in the areas of spatial modeling (variograms), kriging and other techniques, such as kriging and universal kriging (QUEIROZ, 2003), and thus geostatistics has made great progress. The 1990s were the period when several ideas were introduced in South Africa, such as co-kriging of virgin areas using limited data from drilling holes and regularized adjacent data from other explored areas, and practical studies of the effects and implications of bias conditionals in block estimates.

The discovery and modeling of these patterns of spatial correlations allow a better understanding of the underlying physical processes, as well as assist in spatial interpolation. In general, it is desired to estimate the concentration of high values of a given element - and to assess its connectivity in space or time - instead of the spatial mean values, and therefore, the generated uncertainties generally need to be documented in a quantitative way to assist in making of decision-making. Initially, an exploratory analysis of the data is performed. In these exploratory analyzes the most relevant characteristics of the data set of the study area are presented. This purely descriptive part is a preliminary step for the construction of spatial distribution models of the variables used that are used in kriging, which makes estimates of non-sampled values of the study área. The Hg data were treated using the geostatistical procedures, with the objective of generating a probability map of the concentrations of Hg, which exceeded the limit allowed by Conama (0.0002 ppm), and from there to construct classification maps of contaminated areas for the mean and median values. In this case, the values of 80%, 85% and 90% were established, that is, for the 20%, 15% and 10% values above those established by the regulatory body, respectively.

II. MATERIALS AND METHODS LOCATION OF SAMPLE COLLECTION POINTS

To select the sampling sites for water samples in 2014, 37 samples were used in the first campaign (July 18-28, 2014) and 45 samples in the second campaign (December 13-20, 2014). total of 82 samples, in the period from rainy to less rainy in the Amazon basin, respectively (Figure 1).

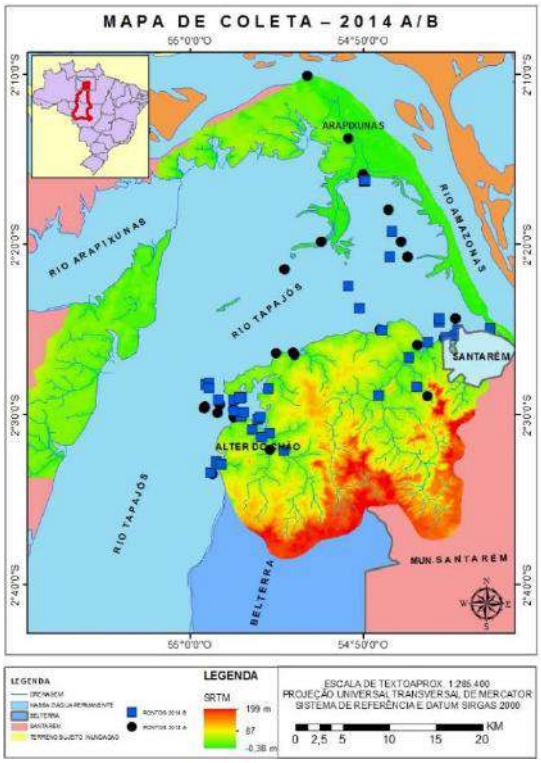

Fig.1 - Sampling area in Santarém, with the respective collection points in the first and second campaigns of 2014.

Elaboration: Author of the research (2016)

Mercury determination contents in samples

The laboratory analyzes to determine the total mercury values found in the samples were performed by Atomic Absorption Spectrophotometry, with cold vapour generation, at the Central Laboratory of the State of Pará, Belém-PA. In the field, about 5 liters of samples were collected in polypropylene flasks previouly treated in acid bath. The results had as reference the resolution n. 357/05, of CONAMA/BR. The decantation / flocculation procedure with aluminum sulphate was done by emptying the supernatant in the field and transferring the moist residues to Falcon tubes.

Geostatistical method

Initially the exploratory analysis was carried out to determine if the sample distributions satisfy the requirements (normality and stationarity) for the construction of the geostatistical models. Then, the spatial distribution is modeled by means of variograms. In the classification of contamination risk in the study area, geostatistical techniques were used to characterize the area in order to know the estimates of the magnitude, extent and location of contaminated areas in non-sampled locations, with the inclusion of associated uncertainty measures. All Hg data were treated using geostatistical

https://dx.doi.org/10.22161/ijaers.69.14 *ISSN: 2349-6495(P) | 2456-1908(O)*

procedures, which allowed the analysis and construction of variable maps from spatially distributed data to infer results of the location and risk of contamination along the mouth of the Tapajós River.

III. RESULTS AND DISCUSSION

Analytical results for water in 2014

The Hg values in the samples collected along the Arapixunas Hole, especially at the entrance to the Amazon River, were elevated, and may be related to the large amount of organic matter in suspension brought by this river into the small hole. At this site, it receives a significant volume of muddy river waters, forcing it into the mouth at its opposite end.

It was observed that the concentration of 5.15 (µg / L) in Boca do Arapixunas (Foz do Amazonas) would be an out lie, which would require a more detailed monitoring of Amazonas' contribution to the system. Concentrations in 5 samples of the first season of 2014, Ponta do Tauá, Foz do Tapajós (Ponta do Cururu), Foz do Tapajós (Sample 4) and Foz do Tapajós (Sample 5) show optimal detection limit (LOD - 0.011 ppb) , less than can be quantified by this experimental procedure used in this work. Therefore, it can not be stated that there are Hg concentrations in the samples in question, but they were not determined and quantified by this technique.

The average found for samples from the first campaign of 2014 was 1,146 (µg / L) average above 0.119 µg / L, found in the river Rato, por Silva (1997) and in the Acre tributaries of 0.116 µg / L, by Mascarenhas et al. al. (2004). In the samples from the second campaign of 2014, only 4 (four) samples: Boca do Igarapé do Camarão, Boca do Igarapé do Camarão (Direct Sample), Igarapé do Miritiapina (Nascente II) and Igarapé Miritiapina (Direct Sample) (LOD) above the detectable. The remaining samples, 41, could not be quantified because they were below the LOD. This fact can be justified because it is a drought period and most of the samples are within the mouth, a fact that facilitates the adsorption of mercury in this type of environmen.

Key Descriptive Statistics for the Hg Variable in 2014

In the evaluation of the mercury concentration data, Table 1 presents the descriptive statistics for the months of July and December of 2014, in which the values occur well above those established by CONAMA, mainly in July. In December, most of the values (more than 75%) are below the LOD. Due to the large number of values below the LOD, greater variability is observed in the month of December in relation to July. This is shown by the standard deviations and the mean and median measurements that are most distant from each other in the month of December.

Table 1 - Statistical summary for mercury concentrations (ppb), 2014

Statistic	Dez.	Jul.
Minimum	0,011	0,011
Quantil 25	0,011	0,710
Mediana	0,011	1,020
Mean value	0,443	1,155
Standard deviation	2,622	1,016
Quantil 75	0,011	0,710
Maaximum	17,6	5,15
Interval	17,589	5,139
Score	45,000	37,000
Conama/357**	0,2	0,2

(*) LOD < 0,011 ppb
** CONAMA RESOLUTION 357/2005
Elaboration: Author of research (2016)

Results of geostatistical analyzes

The data were submitted to geostatistical analysis to perform the mapping of mercury Concentrations. According to Guimarães (2004), the choice of the variogram model to be used is one of the most important aspects of Geostatistics (Figure 2).

All calculations depend on the adjusted variogram model, and therefore, if the adjusted model is not appropriate, all of the following calculations will contain errors that may affect the inferences.

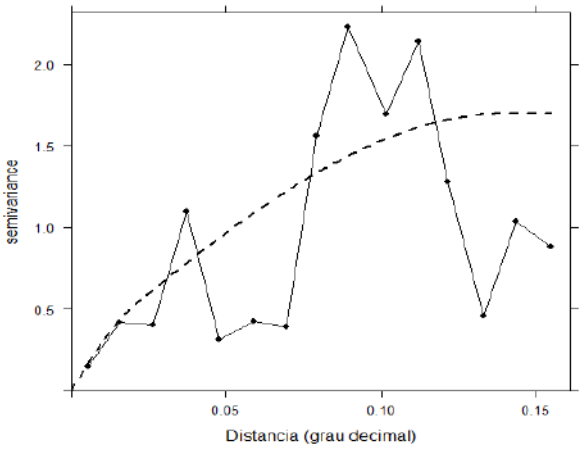

Fig.2 – Experimental semivariogram (continuous line) and fitted model (dashed line) for Mercury.

Elaboration: Author of the research "R" (2016)

https://dx.doi.org/10.22161/ijaers.69.14 *ISSN: 2349-6495(P) | 2456-1908(O)*

With the results of the semivariographic model, kriging could be used to calculate the estimates of mercury concentration values in non-sampled locations in the field. With the mesh of interpolated points, we have a greater detail of the area under study, and a better visualization of the behavior of the variable in the region, due to the increase in the number of observations (DEUTSCH; JOURNEL, 1997).

From the data interpolated by kriging the map of the distribution of mercury concentration in the study area (Figure 3) was constructed, where two zones of concentration Hg can be observed along the mouth of the Tapajós. The Lago Preto region, in the community of Itaparí, on the right bank of the river, and the internal mouth of the Arapixunas hole (region within the mouth: Arapixunas mouth), these are the places that are most likely to be contaminated by Hg.

It was not possible to construct the concentration map in the second campaign because most of the samples were below the detection limit of the method. In this campaign, only four points could be quantified.

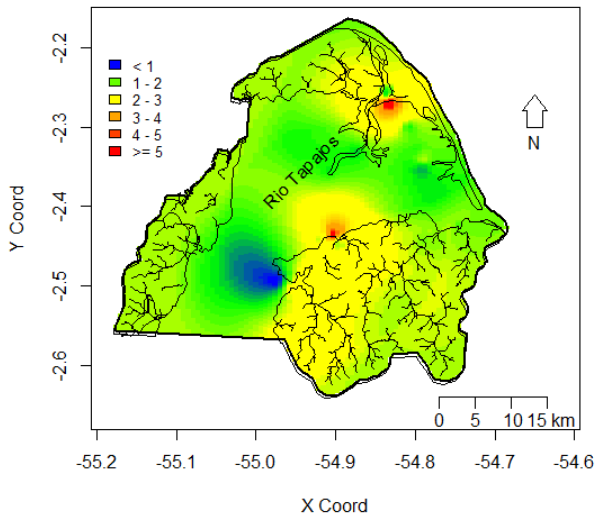

Fig.3 - Map of the concentration of Hg for samples 2014 A, with hydrography
Elaboration: Author of the research (2016)

IV. MAPS OF CHALLENGES OR CONTAMINATION RISKS

Local uncertainty models for risk of contamination

A non-sampled location can be classified based on the estimate of its true value or, alternatively, on the probability that the point is below (or above) a given cut-off value. Estimates involve errors. Errors are subject to costs. If a point is incorrectly classified as high when in fact it is low, there is a cost of super classification (or super estimation). On the contrary, if the point is incorrectly classified as low when in fact it is high, there is a cost of subclassing (or understating).

In the case of environmental contamination, overestimation of the extent of contamination will increase the cost of remediation, but the underestimation of contamination may result in premature loss of life or high cost of health. In such a situation, the cost of underestimation may be much higher than the cost of overestimation. The unit of cost of super estimation and underestimation depends on each situation.

The uncertainty assessment can be represented by probability maps of the concentrations of the study variable. In this case, the probabilities of occurrence above a certain cut-off point, generally defined by legislation, are represented. Figure 4 shows the probability map for mercury, highlighting two regions with probability above 80% of the concentrations presenting values above 0.0002 ppm (limit established by CONAMA). These sites were identified in the regions of Arapixunas and Itaparí, left and right bank of Tapajós, respectively.

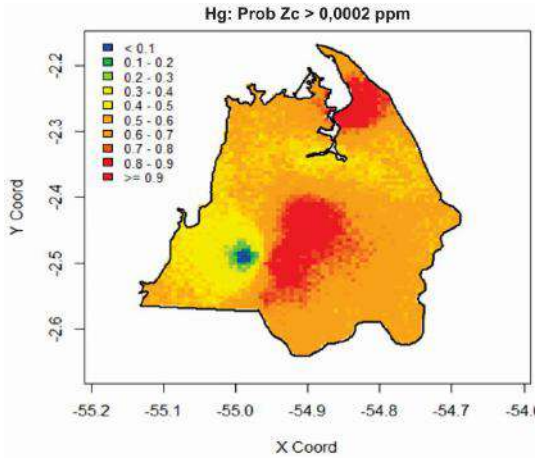

Fig.4 - Probability maps of Hg concentrations exceed the maximum permissible limit of 0.0002 ppm
Elaboration: Author of the research (2016)

Classification maps with probability of contamination above 80%, 85% and 90%

Based on the probability map it was possible to construct classification maps of the contaminated areas for the mean, median or quantil values. In this case, maps with quantiles, 80%, 85% and 90%, that is, for the 20%, 15% and 10% values above those established by CONAMA, respectively, were elaborated. The research area corresponds to 115,950 km2, from the results generated and the size of the pixels of the vector produced, it was possible to reach the sizes of the areas classified as contaminated or uncontaminated, with each pixel having an area of 100x105 m.

https://dx.doi.org/10.22161/ijaers.69.14 *ISSN: 2349-6495(P) | 2456-1908(O)*

For the classification map that used the 80% quantil (Figure 5), the contaminated area (in red on the map) corresponds to 30.06% of the total area, which corresponds to 34.06 km2, and 69.93% of probability that the area is not contaminated, that is, 81.89 km2, of the research area.

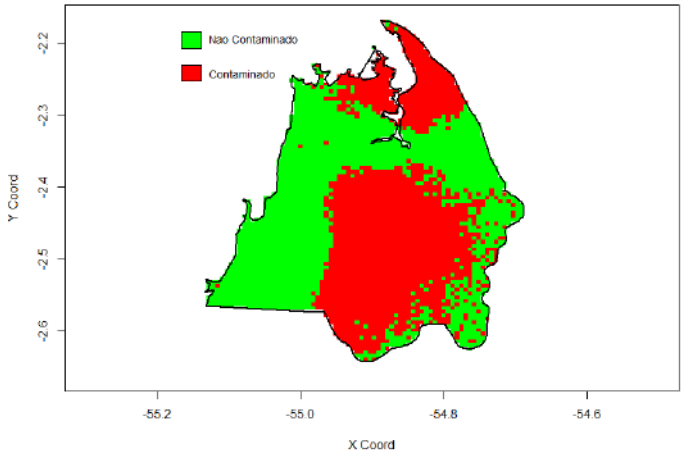

Fig.5 - Classification Map with probability above 80% of Hg contamination exceeds the allowed maximum limit of 0.0002 ppm

Elaboration: Author of the research (2016)

For the classification of locations based on the probability that concentrations above the maximum permissible limits were greater than 85% of contamination (Figure 6), the following values were found: of 7.81% probability of the area being contaminated, or 9, 05 km2, and 92.18%, probability of the area not being contaminated or 106.89 km2.

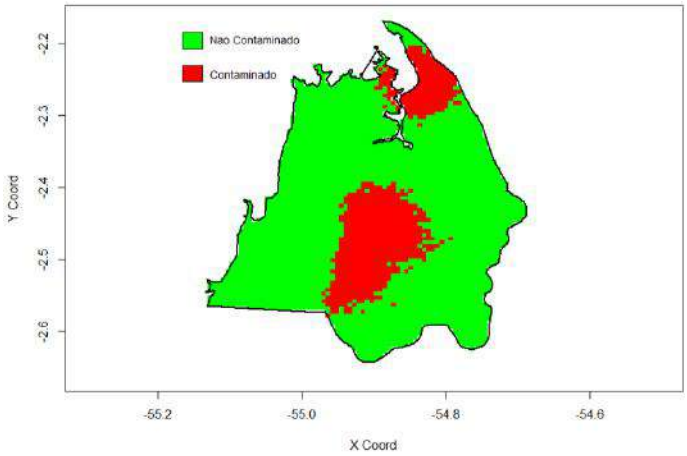

Fig.6 - Classification Map with probability above 85% of Hg contamination exceeds the allowed maximum limit of 0.0002 ppm

Elaboration: Author of the research (2016)

For classification of locations based on the probability that concentrations above the maximum permissible limits are greater than 90% of contamination (Figure 7). These values are 7.81% probability of the area being contaminated or 3.30 km2, and 92.18%, probability of the area not being contaminated or 106.89 km2 of the studied area.

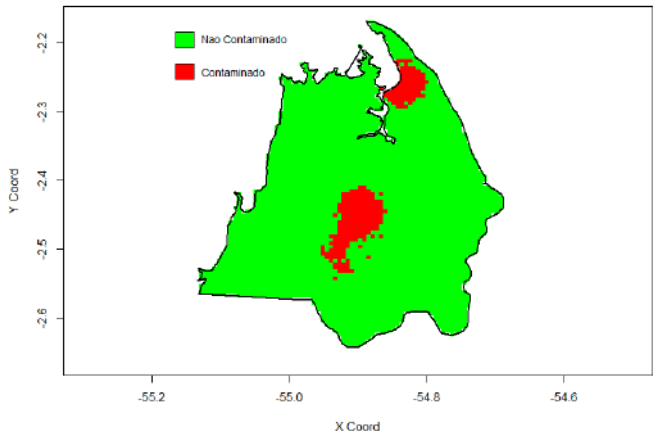

Fig.7 - Classification Map with probability above 95% Hg contamination exceeds the allowed maximum limit of 0.0002 ppm

Elaboration: Author of the research (2016)

V. DISCUSSION OF RESULTS

Among the spatial analyzes performed in the Hg data, considering the months of July and December, it was observed that the distribution of Hg values does not occur in the same proportion in the two periods. The samples that presented higher values of mercury occurred predominantly in July and suffered a retraction in December, especially along the mouth, being able to be associated to the adsorption of this metal. The highest values in the Tapajós river flood period are related to the possible enrichment of Hg concentrations in the suspended solids in this region, due to regional soils and the increase of erosion caused by the expansion of agriculture, according to Gomes (2007).

The pattern of the spatial distribution of the values presented in the probability maps suggests that in the period of July the processes of deposition and mobilization of the Hg in the sediment predominate, since the greater adsorption of the mercury is associated to the increase of the contents of compounds (oxides and hydroxides) of iron, aluminum and manganese and organic matter in the sediments. In them, the ionic content of sodium and potassium, which is quite high, contributes significantly to the increase of the local ionic strength, acting in a way to promote the mobilization of mercury. In the sediments, mercury is associated with organic matter and little influence has the oxide-hydroxides present,

https://dx.doi.org/10.22161/ijaers.69.14 *ISSN: 2349-6495(P) | 2456-1908(O)*

evidenced in the triangular diagram (Hg / Fe / Al) (HYPOLITO, 2005 and LONGO, 2012).

It is at this time that the largest contribution of material transported from the highest areas to the flat ones occurs, especially of particulate matter, functioning as an important transport vehicle of Hg and is attributed to this erosion process through the superficial drainage of rainwater after washing and leaching of the soils of the region, carrying trace elements to the talvegue (GOMES, 2007).

With the arrival of December, the Hg is adsorbed to the sediments of the mouth and they are transported to the hydrological system of the mouth of the Tapajós, until more distant area (PALHETA, 2011). The transport of this mercury occurs more efficiently in areas close to the canal, since they present a great flow and as the Tapajós is a river of drowned mouth (SOUSA, 2009), the narrowing of the channel near the urban area of Santarém, undertakes to the great river strength and speed, interconnecting it to the Amazon. It was observed in field work that in this area there is a very large flow of water that drains the mouth into the Amazon River, thus facilitating the transport of sediments from the bottom of the mouth of the Tapajós, with mercury adsorbed to the Amazon (LACERDA, 2009).

The spatial distribution of samplings by ordinary kriging evidenced, points to areas of higher concentration of Hg, related to regions of higher sediment deposition, presence of organic matter in large concentrations, as in the mouth of Arapixunas and Itapari community. Such direct observations on probability maps show a direct correlation of the presence of organic matter and higher concentration of Hg. Although it is not conclusive to establish a direct relationship between these values, it is possible to make a correction between the formation of preference zones of sediment deposition and accumulation of mercury (JAQUET, 1989).

The presence of the Arapixunas hole, which acts as a connecting channel between the Amazonas and Tapajós rivers, is another factor to consider, because in July, the Amazon basin facilitates the deposition of sediments by the Amazon within the mouth of the Tapajós and the reverse direction around the month of December, hence the association with the high values found in Boca do Arapixunas. A similar phenomenon is pointed out by Maurice-Bourgoin et al. (1999), when studying the Beni River, claiming that Hg adsorbed the sedimentary particles is enriched by the regional soils in oxide and Fe hydroxide during the rainy season. Thus, it would be transported to the lower area and, by analogy, this same phenomenon may be occurring at the mouth of the Tapajós.

Another factor to be taken into account, as pointed out by the specialized literature, is the presence of the Alter-do-Chão Formation in the surroundings of the mouth, which would have an important contribution to this correlation, since it is a region of higher average altitude than those of the surrounding of the mouth and has a great concentration of Fe, that would make important connections with the Hg, associated with the organic matter deposited by the Amazon, which would justify the high values found in the locality (Brauba, 2010; Wasserman, 2001).

Deforestation, monoculture and subsistence agriculture, responsible for the erosive process along the upstream mouth, releases the mercury contained in the soil and drags the mercury adsorbed to the organic and inorganic particles into the aquatic system, thus another variable to be taken into account to justify the high quantified value of Hg at some points in the sampled area (LACERDA, 2009).

Taking into account that the Tapajós river basin, over the decades, has been greatly impacted by agropastoral and mineral projects, and large projects, such as the construction of hydroelectric plants in progress or projected, may be another factor responsible for this contamination and observation of values higher in future samples, when due to the large hydroelectric projects upstream of the basin are in progress or implanted.

A atividade mineradora artesanal, ao longo das últimas décadas, é outra variável a ser considerada, pois, os garimpos artesanais ao longo das décadas de 1980 e meados de 1990, contribuíram para remoção do solo do médio e alto curso do rio, assim como a deposição direta de Hg, com o processo de amálgama da queima do ouro, sem a menor tentativa de conter o vapor ou o metal em estado líquido, mesmo considerando que o vapor entraria no sistema global de mercúrio (SANTOS et al. 1995; 2000).

In the month of December, when the second campaign occurred, most of the values (more than 75%) are below the LOD. Due to the large number of values below the LOD, greater variability is observed in the month of December in relation to July. This is shown by the standard deviations and the mean and median measurements that are most distant from each other in the month of December.

These results are noteworthy because it is a period that is not favorable to large concentrations of organic matter, and the adsorption of Hg may be occurring with greater intensity (not quantified by the method), which may have contributed to these results.

https://dx.doi.org/10.22161/ijaers.69.14 *ISSN: 2349-6495(P) | 2456-1908(O)*

VI. CONCLUSION

The use of kriging as an interpolation method was of fundamental importance for the calculation of the estimates of the concentration values of the mercury in location not sampled during the field steps. In this way, it was possible to obtain a greater detail of the study area and better visualization of the behavior of the variable searched throughout the region, which was visualized in the distribution map of the concentrations.

The use of this tool allowed the quantitative evaluation of the concentrations of mercury in the mouth of the Tapajós river. With the mapping of the concentrations, one can have an idea of the locations, their extensions and where the highest concentration levels of mercury are concentrated. With the use of probabilistic or risk maps it was possible to quantify, in percentage or probabilistic terms, the degree of danger that may be being submitted to the population that is located in the areas of greatest risk.

Classification maps of contaminated areas may serve as a basis for remediation, prevention or safety plans by the agencies concerned. This practice is used in various parts of the world, especially when dealing with contamination of anthropic origin, such as industrial waste, garimpos, factories, etc., where classification maps can be used for the negotiation of alternative remediation plans with the responsible actors by the problem.

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https://dx.doi.org/10.22161/ijaers.69.15 *ISSN: 2349-6495(P) | 2456-1908(O)*

Biotic and Abiotic Products for Bean Angular Spot Control

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Abstract**—***Beans (Phaseolus vulgaris) are one of the most important crops in human food, but the occurrence of disease can greatly reduce their productivity. The objective of this work was to evaluate the use of biotic and abiotic products to control angular spot (Pseudocercosporagriseola) in bean crop. Hight Roots® treatments; V6®; Wert Plus®, potassium phosphite; manganese phosphite; Copper phosphite, manganese, fungicide (fentin hydroxide), Ascophyllum nodosum, Bacillus subtilis and Bacillus thuringiensis, acibenzolar-S-methylic (ASM) and Trichoderma asperallum were used in greenhouse and field experiments with IPR Uirapuru cultivar. Biotic to abiotic products controlled angular leaf spot in bean plants. In greenhouse, the lowest values of Area Under the Disease Progress Curve (AUDPC) were obtained with fungicide application, A. nodosum, T. asperellum and copper phosphite, B. subtillis, acibenzolar-S-methyl, potassium phosphite, Hight Roots®, V6® and Wert Plus®. In field, in the first sowing season the treatments with fungicide, A. nodosum, B. thuringiensis and manganese resulted in lower AUDPC in relation to the other products. In the second sowing season, the tested products did not reduce the severity of the angular spot, since the productivity was higher for fungicide treatment. In the health quality of seeds, potentially pathogenic fungi such as Fusarium sp., Colletotrichum truncatum and Phomopsis sp., as well as the saprophytic fungus Aspergillus sp.*

Keywords**— Ascophyllum nodosum, Bacillus spp., phosphite, Phaseolus vulgaris, Pseudocercosporagriseola, Trichoderma spp.**

I. INTRODUCTION

The bean (*Phaseolus vulgaris* L.) is a plant originating from Latin America, grown mainly in tropical and subtropical regions of the globe. This culture is of great importance to Brazil, involving aspects ranging from cultural habit to food security issues. Beans are considered a healthy food, their consumption is a widespread habit in Brazilian society, configuring itself as an important item of the food basket [1].

Factors limiting bean crop productivity include soil correction, fertilization, plant architecture, weed competition, pest occurrence, especially disease occurrence. [4]. The climatic characteristics of Paraná state favor the occurrence of diseases that cause damage to farmers, such as the angular spot [*Pseudocercosporagriseola* (Sacc.)], plant shoot pathogen which is a major bean crop disease [3,5].

Typical symptoms of angular leaf spot can be observed in the leaves, stems and pods of plants. In the leaves, lesions appear as angle-delimited patches of grayish brown coloration, surrounded by a yellowish halo delimited by the ribs. The fungus produces dark sycamons and conidiophores on lesions and when many lesions are present, they may coalesce causing necrosis and premature defoliation. [2].

The control of angular leaf spot can be accomplished with the use of resistant cultivars, integration of cultural practices, such as the use of good quality seeds. However, the most used method is chemical control, with the application of fungicides [6,2].

The development of new technologies to reduce production costs and increase the spectrum of disease control components is a strategy for Brazilian agricultural production.Thus, studies of alternatives for disease control, which go beyond classical chemical control, are of utmost importance [7,8].

Seeking a lower environmental impact and selection pressure of microorganisms, biological control has been

https://dx.doi.org/10.22161/ijaers.69.15 *ISSN: 2349-6495(P) | 2456-1908(O)*

pointed as a method to minimize the use of pesticides and promote crop protection, such as *Trichoderma* fungi,bacteria of the genus *Bacillus*, the algae *Ascophyllum nodosum*, among others[9,11,12]. In addition to biotic products, there are abiotic formulations used for plant disease control, such as acibenzolar-S-methyl (ASM), balanced plant nutrition with micronutrients and phosphites[10,13].

The objective of this work was to evaluate different biotic and abiotic treatments in the control of angular leaf spot in bean plants in greenhouse and field, as well as to evaluate the health quality of seeds from the field.

II. MATERIAL AND METHODS

The experiments were conducted in a greenhouse and field belonging to the Ponta Grossa State University (UEPG)/Brazil. In greenhouse, three seeds of the IPR Uirapurucultivar, black bean variety, with an average cycle of 86 days, susceptible to angular leaf spot, were sown in plastic pots (3.0 L capacity) with vegetable substrate (pine, eucalyptus bark and ash). Two repetitions of this experiment were performed.

The treatments used were: High Roots® (N 18%; K_2O 6%), V6® (Mn 2.5%; Zn 1.9%; Mo 0.16%), Wert Plus® (Cu 4%; Mn 6%; Zn 3.9%), potassium phosphite (P_2O_5 26%; K_2O 19%), manganese phosphite (P_2O_5 36%; Mn 7.0%), copper phosphite (N 11%; P_2O_5 22%; S 1.76%; Cu 4%), Manganese (Mn 10%; S 5.48%), fungicide (Mertin® - phentin hydroxide, 40 m/m i.a), the algae*Ascophyllum nodosum* (Acadian® - K_2O 5.3%; total organic carbon 6.0%), *Bacillus subtilis* (Serenade® - 13.68 g L^{-1}, 1.34% - 1 x 10^9 CFU g^{-1}), *Bacillus thuringiensis* (Dipel® - 32 g Kg^{-1}, 3.2% - 25 billion viable $sporesg^{-1}$), *Trichoderma asperellum*(Quality® - isolted SF 1.0 x 10 UFC g^{-1}), acibenzolar-S-methyl – 50 m/m i.a (Bion®) and control (distilled water). Products were sprayed when the bean plants were in the vegetative stage V3 (first developed trifoliate).

The inoculation of *P. griseola* pathogen was performed by spraying conidia suspension, produced in tomato culture medium [14], three days after the application of treatments throughout the plant. After inoculation, the plants were kept in a humid chamber with moistened transparent plastic bags at room temperature for 48h[15].

Disease severity assessments began with the onset of symptoms, and cotyledonary leaves were evaluated up to the third trifoliate of each plant, with a two-day interval at each evaluation, using a diagrammatic scale [16], totaling 10 evaluations. From the severity data the area under the disease progress curve (AUDPC) was calculated[17].

The experimental design was completely randomized, with fourteen treatments and ten replications, where each pot with three plants was considered a repetition.

The field experiment was conducted at the Capão da Onça Experimental Farm, which belongs to the Ponta Grossa State University (25°5'49"south latitude, 50°3'11" east longitude and 1,025 m altitude) in the municipality of Ponta Grossa-PR/Brazil. The predominant climate according to Köppen is Cfb type, with cool summers and frequent frosts during winter, with no defined dry season. Maximum and minimum temperatures are 22 and 13ºC, annual average precipitation from 1,600 to 1,800 mm [18].

Field evaluation for angular spot control was carried out in two sowing seasons, first season occurred on November 4, 2015 and second season on December 21, 2015, with the IPR Uirapurucultivar. The experimental design was randomized blocks with 12 treatments and 4 replications. Crop sowing was performed in direct sowing system in the straw, with row spacing of 0.45 m and population of 15 plants m^{-1}. The treatments used were the same as those used in the greenhouse, except for the *Trichoderma asperellum* treatment which was not used under field conditions.

The first crop applications were made at 15 days after emergence (DAE) (stage V3), 32 DAE (R6 - first flower) and at 47 DAE (R7 - pod formation). In the second season, applications were made at 15 DAE (V4), 29 DAE (R6) and 47 DAE (R7). Five angular leaf spot severity assessments were performed, estimating the percentage of leaf tissue attacked,with the aid of diagrammatic [16] and after was calculated AUDPC[17].

At the end of the crop cycle, data were collected on yield components plants per meter, pods per plant, grains per pod. Plants were harvested from a useful area of 8.0 m^2. The first crop was harvested at 93 DAE and the second at 96 DAE.

The seeds harvested in the field were submitted to the Blotter pathology test method [19]. 200 seeds were used from each treatment, divided into eight repetitions of 25 seeds. The seeds were individually placed on two sterilized blotting paper sheets moistened with sterile distilled water inside the gerbox. The gerbox seeds were incubated in a BOD chamber at 24 ± 2°C for seven days under 12 hours of light and 12 hours of darkness. The evaluation was performed after seven days of incubation, individually examining all seeds.Fungi were identified at the gender level, based on their morphological characteristics [20], the incidence being expressed as a percentage.

For analysis the pathogen incidence data in the seeds were transformed into arc sen $\sqrt{(x + 0.5) / 100}$. All data were subjected to analysis of variance by the F test and means

https://dx.doi.org/10.22161/ijaers.69.15 *ISSN: 2349-6495(P) | 2456-1908(O)*

compared by the Scott-Knott test at 5% significance, using the statistical software R version 2.13.2.

III. RESULTS AND DISCUSSION

The severity of angular leaf spot in a greenhouse was low, only 14 days after pathogen inoculation, it was possible to observe symptoms in the first experiment and 18 days after inoculation in the second experiment.

In the first experiment, symptoms were initially observed in cotyledonary leaves and later in the first trifolium (Table 1). The values observed in the 1st trifolium were lower than the values observed in the cotyledon leaf, however higher than the 2nd and 3rd trifolium, indicating that treatments reduced the disease development in some way (Table 1).

In the first trifolium the treatments with lower values of AUDPC were the biological treatments with *A. nodosum, B. subtillis* and *T. asperellum*, the ASM inducer and copper and potassium phosphites. The other treatments did not differ statistically from the control, except Wert Plus® and manganese phosphite, which presented higher values in severity. In the second trifolium no statistical difference was observed between the treatments, while in the third trifolium the *B. subtillis* treatments, and the nutrients Hight Roots®, V6® and Wert Plus®, were the only treatments that did not differ statistically from the control.

An alternative to control plant diseases is the use of algae and among them stands out *A. nodosum* [21]. Seaweed polysaccharides have been shown to be potential resistance inducers in plants [22]. Borsato, Di Piero and Stadnik [23] evaluated the ability of ulvana algae to induce resistance in three bean cultivars against *Uromycesappendiculatus* (Pers) Unger., Causal agent of rust. Polysaccharide spraying did not affect the number of rust pustules/cm^2, but promoted an average reduction of 23.8% in rust diameter in bean plants.

Among the biological agents in disease control, we highlight the fungi of the genus *Trichoderma*. De Meyer et al. [24] applied *T. harzianum* T30 conidia seven days before the inoculation of *Botrytis cinerea* (De Bary) Whetzel on beans and observed significant reductions in disease. The authors reported a 35% reduction in disease severity and, as they did not find leaf fungus, the authors attributed the decrease in disease symptoms to antagonist-activated resistance induction.

Phosphites may act in a fungistatic manner in addition to fungitoxic. In bean culture, Gadaga et al. [13] evaluated the effect of different phosphite formulations on plant protection against anthracnose. The authors observed lower AUDPC in plants that received applications of K and Mn phosphites compared to control, being the K, Zn and K phosphites + salicylic acid also effective in controlling the disease.

In an experiment conducted in a greenhouse, Gontijo Neto et al. [6] observed that bean plants treated with ASM had 23% lower severity than treatment where there was no control of angular leaf spot. Plants that were sprayed with fungicide (methyl thiophanate + epoxiconazole + piraclostrobin) achieved a 40.84% reduction in disease progress.

In the second experiment (Table 2), disease development was slower (18 days after inoculation), which justifies zero values in some tests for cotyledon leaf evaluation, since it is introduced in senescence before disease. Symptoms in the 1st, 2nd and 3rd trifolium were more expressive when compared to experiment 1 (Table 1).

The control showed greater severity of the disease in all trifoliums (Table 2), presented higher values, but did not differ statistically from treatment *B. subtillis* and copper phosphite in the 2nd trifolium. It is no longer the third trifolium,in addition to the controls mentioned,manganese treated plants with higher disease severity.

In the first trifolium (Table 2) the lowest AUDPC values were observed in the procedures with fungicide and potassium phosphate.Already in the 2nd trifolium, there was a reduction of the disease in all cases with the lowest value of AUDPC: fungicide, *A. nodosum*, *B. thuringiensis*, *T. asperellum*, ASM, manganese and potassium phosphate, in addition to the nutrients Hight Roots® and Wert Plus®. The other controls did not differ statistically from the witness.

In the 3rd trifolium all treatments showed a reduction in AUDPC, except *B. subtillis*, copper phosphite and manganese nutrient, which did not differ statistically from the control.

Most pathogenic fungi invade the apoplast releasing pectolytic enzymes that dissolve the leaf's middle lamella [25]. The activity of these enzymes is extremely inhibited by calcium, also present in Hight Roots® fertilizer, which strengthens the plant cell wall, explaining a negative correlation between calcium content and disease severity [26].

Potassium phosphite treatment also showed significant disease control in all trifolium. Potassium is the only macronutrient that presents consistent positive results in reducing the incidence of disease, as its deficiency causes accumulation of soluble amino acids, which are pathogen nutrients.[26].

Regarding the field experiments, at the time of the first application of the products, the presence of angular stain symptoms had not yet been found. Anthracnose (*Colletotrichum lindemuthianum* (Sacc. &Magn. Lams. Scrib) was the disease that occurred first and most severely

https://dx.doi.org/10.22161/ijaers.69.15 *ISSN: 2349-6495(P) | 2456-1908(O)*

in both experiments sowing seasons. Negative correlation between anthracnose and angular leaf spot was observed in plants where high anthracnose rates were observed, low angular spot rates were found and vice versa, possibly due to competition for feeding site [13].

The first symptoms of angular leaf spot were observed only in the last two evaluations in the first season, at 51 DAE and 59 DAE; and in the second sowing season in the last three assessments, at 45, 55 and 64 DAE (Table 3).

In the first sowing season all treatments presented lower AUDPC compared to control (Table 3). Treatments with better disease control were chemical control with fungicide, biological controls with algae *A. nodosum*, bacterium *B. thuringiensis* and fertilizer V6®. The other treatments did not differ statistically among themselves.

The use of seaweed has been an ecologically sustainable alternative in the control of plant diseases. Several studies have pointed out the potential use of algal extracts, such as *A. nodosum*, to increase plant development, sometimes with consequent increases in yield, also increased tolerance of plants to biotic and abiotic stresses. [21, 28].

Due to the growing search for control alternatives to phytopathogens, the biological method has been gaining large space and bringing positive results. Species of the genus *Bacillus* are considered potential biocontrol agents of leaf and soil pathogens [28]. These bacteria produce a wide range of bioactive lipopeptides, compounds that suppress plant pathogens through the mechanism of antibiosis.[29].

Another treatment with lower angular leaf spot severity was V6® leaf fertilizer (Table 3). This treatment consists of manganese (2.5%), zinc (1.9%) and molybdenum (0.16%). The effects of mineral nutrition on crop growth and productivity have been reported and can act by altering plant resistance against disease. [30].

The nutrient molybdenum can also indirectly contribute to disease prevention, as it participates in the activation of the enzymes nitrate reductase and nitrogenase, which are key to higher plant nitrogen metabolism [25]. Zinc is one of the main micronutrients of plant nutrition, as it participates in various metabolic processes, as well as contributing to decrease or intensify the incidence of some diseases. [31].

Also as an alternative to chemical control of diseases, there is the use of phosphites. These can act directly or indirectly on the pathogen, inducing systemic resistance in plant by the synthesis of phytoalexins, phenolic compounds and PR-proteins (pathogenesis-related proteins)[32].

At the end of the culture cycle yield components were evaluated. In the first sowing season there was a statistical difference for the number of pods per plant and number of beans per pod variables. There was no significant difference between treatments for plants per meter and productivity variables (Table 4).

In the second sowing season the fungicide, *B. subtillis*, copper phosphite and Wert Plus® treatments presented lower number of plants per meter. The other treatments did not differ statistically among themselves. For number of pods per plant, the only treatments that differed statistically from the control were *A. nodosum, B. subtillis* and manganese phosphite. For the variable grain per pod, treatments that did not differ from the control were *A. nodosum, B. subtillis* and manganese (Table 4).

According to Kuhn &Pascholati [33] a variety of situations can occur while developing a plant along with the resistance induction process. One of the changes can be mainly due to the variation in plant growth conditions. Due to this, productivity shows dependence on the inducer dose, nutritional condition and biological interaction to which they are subjected.

In the harvested seeds evaluation, in both sowing seasons, there was incidence of pathogenic and saprophytic fungi (Table 5). Seeds are the most efficient spreading agent of pathogens and aid their survival [34]. The distribution of infected seeds is random and provides primary outbreaks of field infection in the early phase of the crop [35].

In the first sowing season, the potentially pathogenic organisms found in the pathology test [19] were *Fusarium* sp. and *Colletotrichum truncatum* (Table 5). *Fusarium* sp. had higher incidence in the control, in the treatment A. nodosun and *B. subtillis*, potassium phosphite and High Roots® fertilizer. The treatments with the lowest incidence of the pathogen were ASM inducer and V6® and Wert Plus® leaf fertilizers. The other pathogen detected in the present work was *Colletotrichum truncatum*. The highest incidence was found in fungicide treatments, biological control with *A. nodosun*, *B. thuringiensis*, ASM inducer, copper phosphite and Wert Plus® nutrient (Table 6).

In the second sowing season there was an incidence of the pathogens *Fusarium* sp., *Phomopsis* sp. and *Aspergillus* sp. (Table 6). The treatments *B. thuringiensis*, ASM, manganese phosphite, Hight Roots®, V6® and Wert Plus® presented lower incidence of Fusarium sp. in relation to the other treatments. For the incidence of *Aspergillus* and *Phomopsis* there was no statistical difference between treatments.

The genus Fusarium sp. may cause bean crop to wilt or yellowing of fusarium caused by the species*Fusarium oxysporum*(Schlecht.) f. sp. *phaseoli* (Kendrick & Snyder). This pathogen occurs in virtually all producing regions of

https://dx.doi.org/10.22161/ijaers.69.15 *ISSN: 2349-6495(P) | 2456-1908(O)*

Brazil, its importance has increased mainly in intensive cultivation of the same crop in the same area [36].

Colletotrichum truncatum causes bean disease called bean scab, with damage that can reach 100% of the crop [37].

Trade and use of saved seeds is a reality in developing countries. In this system, over 80% of farmers are involved in the selection, production, dissemination, sales, exchanges or donations that occur in the local community [38]. In Brazil, bean farmers usually use part of the grain produced as seeds in later crops [39].

IV. CONCLUSION

Biotic to abiotic products controlled angular leaf spot in bean plants.

In greenhouse, the lowest AUDPC values were obtained with fungicide (fentin hydroxide), *A. nodosum*, *T. asperellum* and copper phosphite, B. subtillis, acibenzolar-S-methyl, potassium phosphite, Hight Roots®, V6® and Wert Plus® treatments.

In field, in the first sowing season the application of fungicide, *A. nodosum*, *B. thuringiensis* and manganese resulted in smaller AUDPC. In the second sowing season, the tested products did not reduce the severity of the angular spot, since the yield was higher when applied fungicide.

There was an incidence of potentially pathogenic fungi such as *Fusarium* sp., *C. truncatum* and *Phomopsis* sp. and the saprophytic fungus *Aspergillus* sp.

ACKNOWLEDGEMENTS

To State University of Ponta Grossa (UEPG) and CAPES (Coordination of Improvement of Higher Education Personnel).

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Table 1 - Area under the disease progress curve (AUDPC) of Pseudocercosporagriseola in bean plants (Phaseolus vulgaris), on cotyledon leaf, first trifolium, second trifolium and third trifolium, as a function of the products performed in beans under greenhouse conditions – second repetition.

Treatments	Cotyledonleaf	1st Trifoliumleaf	2nd Trifoliumleaf	3rd Trifoliumleaf
Control	5.98 b[1]	3.42 b	0.88[2]	0.08 b
Fungicide	1.38 d	2.43 b	0.76	0.00 b
Ascophyllum nodosum	0.95 d	1.35 c	0.92	0.04 b
Bacillus thuringiensis	3.82 c	2.51 b	0.10	0.00 b
Bacillus subtillis	5.89 b	1.60 c	0.52	0.22 a
Trichoderma asperellum	1.61 d	1.91 c	0.10	0.00 b
Acibenzolar-S-methyl (ASM)	2.30 c	1.16 c	0.00	0.00 b
Copper phosphite	0.95 d	1.18 c	0.93	0.00 b
Manganese phosphite	7.20 b	6.29 a	0.63	0.06 b
Potassium phosphite	3.12 c	1.04 c	0.02	0.00 b
Hight Roots®	2.68 c	2.96 b	0.10	0.30 a
Manganese	2.54 c	2.49 b	0.42	0.00 b
V6®	6.03 c	2.94 b	1.55	0.30 a
Wert Plus®	10.48 a	5.12 a	1.67	0.48 a
C.V (%)[2]	33.89	35.46	16.42	4.96

(1) Means with the same letter in the column do not differ significantly by Scott -Knott (p>0.05).
(2) Not significant;
(3) Coefficient of variation.

Table 2 - Area under the disease progress curve (AUDPC) of Pseudocercosporagriseola in bean plants (Phaseolus vulgaris) on cotyledon leaf, first trifolium, second trifolium and third trifolium, as a function of the products performed in beans under greenhouse conditions – second repetition.

Treatments	Cotyledonleaf	1st Trifoliumleaf	2nd Trifoliumleaf	3rd Trifoliumleaf
Control	0.00 b[1]	7.93 a	3.14 a	1.44 a
Fungicide	1.58 b	0.66 d	0.46 b	0.60 b
Ascophyllum nodosum	0.00 b	2.74 c	0.82 b	0.50 b
Bacillus thuringiensis	0.00 b	2.74 c	1.55 b	0.03 b
Bacillus subtillis	0.72 b	3.73 c	2.17 a	1.15 a
Trichoderma asperellum	3.76 a	4.00 c	0.93 b	0.20 b
Acibenzolar-S-methyl (ASM)	0.92 b	2.26 c	0.32 b	0.12 b
Copper phosphite	0.12 b	2.95 c	2.70 a	1.30 a
Manganese phosphite	0.00 b	5.48 b	1.42 b	0.24 b
Potassium phosphite	0.00 b	1.24 d	0.62 b	0.20 b
Hight Roots®	0.00 b	5.03 b	1.21 b	0.00 b
Manganese	0.00 b	2.36 c	1.92 a	1.70 a
V6®	0.00 b	2.38 c	1.46 b	0.26 b
C.V (%)[2]	32.59	36.33	15.26	12.51

(1) Means with the same letter in the column do not differ significantly by Scott -Knott (p>0.05).
(2) Coefficient of variation.

https://dx.doi.org/10.22161/ijaers.69.15 *ISSN: 2349-6495(P) | 2456-1908(O)*

Table 3 - Area under the disease progress curve (AUDPC) of Pseudocercosporagriseola in common bean (Phaseolus vulgaris) on the whole plant as a function of the products performed in beans under field conditions, IPR Uirapuru cultivar - first and second season.

Treatments	1st Season	2nd Season
Control	15.10 a[1]	7.55[2]
Fungicide	0.35 c	7.94
Ascophyllum nodosum	0.09 c	7.86
Bacillus thuringiensis	2.94 c	5.26
Bacillus subtillis	7.10 b	7.22
Trichoderma asperellum	5.28 b	5.09
Acibenzolar-S-methyl (ASM)	7.19 b	5.68
Copper phosphite	4.27 b	6.95
Manganese phosphite	5.98 b	6.93
Potassium phosphite	4.33 b	7.02
Hight Roots®	5.76 b	7.21
Manganese	3.51 c	6.89
V6®	7.13 b	6.62
C.V (%)[3]	50.34	27.76

(1) Means with the same letter in the column do not differ significantly by Scott -Knott (p>0.05).
(2) Not significant;
(3) Coefficient of variation.

Table 4 - Yield components: plants per meter, pods per plant, grain number and productivity (kg ha^{-1}) as a function of products in beans (Phaseolus vulgaris), IPR Uirapuru, first and second season.

1st Season

Treatments	Plants per meter	Pods per plant	Grainnumber	Productivity (kg ha^{-1})
Control	10.75[2]	121.25 a[1]	673.25 a	3946.13[2]
Fungicide	9.00	89.00 b	504.25 b	2843.48
Ascophyllum nodosum	13.25	93.75 b	542.25 b	3552.67
Bacillus thuringiensis	7.75	79.50 b	441.25 b	3868.59
Bacillus subtillis	9.00	91.00 b	502.00 b	3847.95
Trichoderma asperellum	10.00	91.75 b	501.50 b	2529.13
Acibenzolar-S-methyl (ASM)	10.25	113.00 a	619.75 a	3407.70
Copper phosphite	10.25	121.00 a	692.00 a	3305.38
Manganese phosphite	10.00	126.25 a	687.75 a	3172.07
Potassium phosphite	11.50	122.25 a	491.50 b	2840.41
Hight Roots®	9.00	84.25 b	468.00 b	3484.94
Manganese	9.50	86.75 b	495.50 b	2885.94
V6®	8.75	89.75 b	469.25 b	2704.35
C.V (%)[3]	17.22	17.44	13.51	12.74

2nd Season

Treatments	Plants per meter	Pods per plant	Grainnumber	Productivity (kg ha^{-1})
Control	14.00 a	109.75 a	529.75 b	5001.09 c
Fungicide	11.25 b	112.00 a	595.25 a	8524.17 a
Ascophyllum nodosum	14.25 a	98.50 b	491.50 b	4984.27 c
Bacillus thuringiensis	13.50 a	121.00 a	552.25 a	5361.03 c
Bacillus subtillis	12.50 b	103.25 b	498.25 b	4802.52 c
Trichoderma asperellum	14.25 a	127.00 a	603.00 a	6215.05 b
Acibenzolar-S-methyl (ASM)	11.50 b	114.00 a	594.25 a	5624.34 b

https://dx.doi.org/10.22161/ijaers.69.15 *ISSN: 2349-6495(P) | 2456-1908(O)*

Copper phosphite	13.75 a	93.00 b	546.50 a	6189.08 b
Manganese phosphite	13.75 a	114.75 a	575.50 a	6032.77 b
Potassium phosphite	13.75 a	111.50 a	599.25 a	4672.08 c
Hight Roots®	14.25 a	98.00 b	486.00 b	4817.85 c
Manganese	13.50 a	112.25 a	491.00 b	5709.11 b
V6®	11.00 b	96.75 b	458.50 b	4716.57 c
C.V (%)	11.88	9.62	11.62	14.63

(1) Means with the same letter in the column do not differ significantly by Scott -Knott (p>0.05).
(2) Not significant;
(3) Coefficient of variation.

Table 5 – Incidence (%) of seed pathogens as a function of the products performed in the field in the bean (Phaseolus vulgaris) in the experimental area Fazenda Capão da Onça, first and second season growth.

1st Season			
Treatments	Fungi		
	Fusarium sp.	*Aspergillus* sp.	*Colletotrichum truncatum*
Control	80.50 a[1]	1.00[2]	2.00 b
Fungicide	61.50 b	0.50	5.00 a
Ascophyllum nodosum	82.50 a	0.50	3.50 a
Bacillus thuringiensis	61.00 b	0.00	6.50 a
Bacillus subtillis	77.00 a	0.00	1.00 b
Trichoderma asperellum	29.00 d	0.50	5.50 a
Acibenzolar-S-methyl (ASM)	37.00 c	0.50	6.00 a
Copper phosphite	57.00 b	0.00	0.00 b
Manganese phosphite	77.50 a	1.00	0.00 b
Potassium phosphite	73.50 a	1.50	2.00 b
Hight Roots®	47.00 c	0.00	0.50 b
Manganese	18.50 d	0.00	2.50 b
V6®	28.50 d	0.00	3.50 a
C.V (%)[3]	26.16	13.70	23.78
2nd Season			
Treatments	Fungi		
	Fusarium sp.	*Aspergillus* sp.	*Phomopsis*sp.
Control	33.50 a	1.50[2]	0.00[2]
Fungicide	21.00 a	0.00	2.00
Ascophyllum nodosum	14.50 a	0.50	0.50
Bacillus thuringiensis	0.00 b	0.00	0.00
Bacillus subtillis	22.50 a	0.00	1.50
Trichoderma asperellum	7.00 b	1.00	2.50
Acibenzolar-S-methyl (ASM)	23.50 a	1.00	0.00
Copper phosphite	8.00 b	0.00	0.50
Manganese phosphite	20.50 a	3.00	0.50
Potassium phosphite	0.00 b	0.00	0.00
Hight Roots®	20.50 a	0.50	0.50
Manganese	9.00 b	0.00	1.00
V6®	0.00 b	0.00	0.00
C.V (%)[3]	26.20	14.56	17.28

(1) Means with the same letter in the column do not differ significantly by Scott -Knott (p>0.05); original data, for analysis, were transformed into arc sin $\sqrt{(x + 0.5)/100}$;
(2) Not significant;
(3) Coefficient of variation.

https://dx.doi.org/10.22161/ijaers.69.16 *ISSN: 2349-6495(P) | 2456-1908(O)*

A Continuity Equation For Time Series Water Wave Modeling Formulated Using Weighted Total Acceleration

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Abstract**—** *Continuity equation for wave modeling is still being developed. There are quite a lot of versions of this equation. This research formulates continuity equation in a simple form to simplify its numerical and analytical solution.*

The formulation of the continuity equation is done by performing mass conservation law in a water column with free surface and by performing weighted total acceleration. Then, the continuity equation is performed along with the surface momentum equation and completed numerically to modeling one-dimensional wave dynamism. The equation is capable of modeling shoalingand breaking.

Keywords**— Continuity Equation, Weighted total acceleration equation.**

I. INTRODUCTION

Time series water wave equation is generally called Boussinesq type equation.There are quite a lot of versions of Boussinesq equation, either its continuity equation or water surface equation as well as its momentum equation. Those equations generally consist of the second or higher differential elements which quite complicate the solution both analytically and numerically. Some researcher who have developed Boussinesq equation are among othersBoussinesq, J. (1871), Dingeman, M.W. (1997), Ham;L., Madsen, P.A., Peregrin, D.H. (1993), Johnson, R.S. (1997), Kirby, J.T. (2003), Peregrine, D.H. (1967), Peregrine, D.H. (1972) and many more.

Governing equations in this research are water surface equation and surface momentum equation, both of which use particle velocity at the surface as the variable and both are in the form of time and space differential equation in simple form. Water surface equation is formulated based on mass conservation law and by performing weighted total acceleration at the kinematic free surface boundary condition. The momentum equation is obtained by performing weighted total acceleration at the Euler momentum equation. The integration with water depth from this momentum equation produces surface momentum equation with particle velocity variable at the surface.

Both governing equations are done using numerical method where spatial differential is done using finite difference method, whereas time differential is done using corrector predictor method.

II. TOTAL DERIVATIVE EQUATION

Hutahaean (2019a) developed weighted total acceleration equation at water particle in horizontal direction, i.e.,

$$\frac{Du}{dt} = \gamma \frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} + w \frac{\partial u}{\partial z} \quad \text{.....(1)}$$

$u$is particle velocity in horizontal-$x$direction and$w$is particle velocity in vertical-z direction. Weighted total acceleration, was actually formulated for the function $f = f(x,t)$. However, in this research it is performed at $f = f(x,z,t)$, because the wave being discussed is a wave moving to horizontal-$x$direction and vertical z dimension is eliminated with the integration process, so the equation becomes a function of $f = f(x,t)$.

The changes in total water surface elevation is

$$\frac{D\eta}{dt} = \gamma \frac{\partial \eta}{\partial t} + u_\eta \frac{\partial \eta}{\partial x} \quad \text{.....(2)}$$

$\eta = \eta(x,t)$is water surface elevation against still water level (Fig. 1). In (1) and (2) there is time coefficient or time scale at time differential i.e. $\gamma$with a value of 2.87-3.14 in Hutahaean (2019a,b). The value of γ is very much

https://dx.doi.org/10.22161/ijaers.69.16 *ISSN: 2349-6495(P) | 2456-1908(O)*

determined by basic equation in which the total acceleration was performed. In this research the correspond γvalue of 2.00 is found.

Based on (2), then kinematic free surface boundary condition that was formulated from total derivative equation of the changes of a surface (Dean (1991)), becomes

$w_\eta = \gamma \frac{\partial \eta}{\partial t} + u_\eta \frac{\partial \eta}{\partial x}$ .....(3)

$u_\eta$is the velocity of horizontal-$x$direction at the surface.

III. CONTINUITY EQUATION

3.1. The formulation of continuity equation

Continuity equation or water wave surface equation will be formulated in a water column (Fig.1.) with free water surface, where as a result of an input-output in a water column in a very small time interval $\gamma\delta t$, a change in water surface elevation of $\delta\eta$ occurs so there is also a change in the per width unit volume of $\delta\eta\delta x$. For a very small $\delta x$where$\delta x = dx$

$\delta m = \frac{\rho}{2}\delta\eta dx$ .....(4)

The change in water mass from input-output process (Fig. 1.) is,

$$\delta m = \rho\big(u - (u + \delta u)\big)\delta z\delta t + \big(w - (w + \delta w)\big)\delta x\gamma\delta t$$

$$\delta m = -\rho\left(\frac{\delta u}{\delta x} + \frac{\delta w}{\delta z}\right)\delta x\delta z\gamma\delta t$$

Total change in water mass in the water column at very small δxandδz,

$\delta m = -\rho\int_{-h}^{\eta}\left(\frac{\partial u}{\partial x} + \frac{\partial w}{\partial z}\right)dz\,dx\gamma\delta t$ .....(5)

$h$is water depth against still water level, $\eta = \eta(x,t)$is the water surface elevation also against water level..For incompressible fluid, δmin (4) is the same asδmin (5),

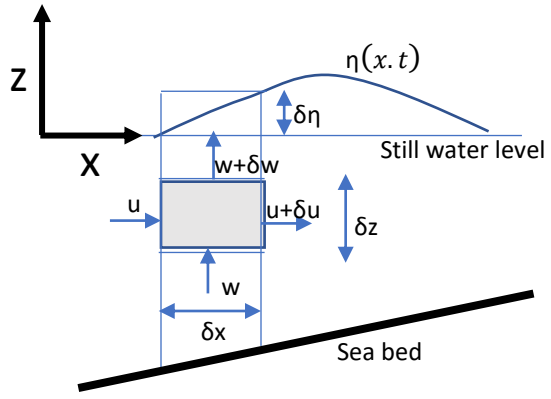

Fig. 1: Water column to formulate continuity equation.

$$\frac{\rho}{2}\delta\eta dx = -\rho\int_{-h}^{\eta}\left(\frac{\partial u}{\partial x} + \frac{\partial w}{\partial z}\right)dz\,dx\gamma\delta t$$

Both sides are divided by ρ, $dx$and$\gamma\delta t$,

$$\frac{\delta\eta}{2\gamma\delta t}dx = -\rho\int_{-h}^{\eta}\left(\frac{\partial u}{\partial x} + \frac{\partial w}{\partial z}\right)dz$$

For a very smallδt,

$$\frac{D\eta}{2\gamma dt} = -\int_{-h}^{\eta}\left(\frac{\partial u}{\partial x} + \frac{\partial w}{\partial z}\right)dz$$

Substitute (2) to the left side of the equation

$$\frac{1}{2}\frac{\partial \eta}{\partial t} + \frac{u_\eta}{2\gamma}\frac{\partial \eta}{\partial x} = -\int_{-h}^{\eta}\left(\frac{\partial u}{\partial x} + \frac{\partial w}{\partial z}\right)dz$$

The integration of the second term of the right side is done and substituted kinematic free surface bondary condition and kinematic bottom boundary condition,

$$\left(\gamma + \frac{1}{2}\right)\frac{\partial \eta}{\partial t} = -\int_{-h}^{\eta}\frac{\partial u}{\partial x}dz - \left(1 + \frac{1}{2\gamma}\right)u_\eta\frac{\partial \eta}{\partial x} - u_{-h}\frac{\partial h}{\partial x}$$ .....(6)

The integration of the first term right side is performed with Leibniz integration (Protter (1985)),

$$\int_\alpha^\beta \frac{\partial f}{\partial x}dz = \frac{\partial}{\partial x}\int_\alpha^\beta f\,dz - f_\beta\frac{\partial \beta}{\partial x} + f_\alpha\frac{\partial \alpha}{\partial x}$$

Obtain,

$$\int_{-h}^{\eta}\frac{\partial u}{\partial x}dz = \frac{\partial}{\partial x}\int_{-h}^{\eta}u\,dz - u_\eta\frac{\partial \eta}{\partial x} - u_{-h}\frac{\partial h}{\partial x}$$

(6),becomes

$\left(\gamma + \frac{1}{2}\right)\frac{\partial \eta}{\partial t} = -\frac{\partial}{\partial x}\int_{-h}^{\eta}udz - \frac{u_\eta}{2\gamma}\frac{\partial \eta}{\partial x}$ .....(7)

Integration in the right side in (7) is done using velocity equation from Dean (1991) and the result of integration is expressed as a function of surface horizontal velocity u_η in order to correspond with momentum equation that produces surface velocityu_η. Velocity potential equation as the result of Laplace equation solution (Dean (1991)) is

$\Phi(x,z,t) = Gcoskxcoshk(h+z)sin\sigma t$ ....(8)

Gwave constant, k wave number andσ angular frequency. Particle velocity in horizontal-x direction is

$$u(x,z,t) = -\frac{\partial \Phi}{\partial x}$$

$= Gksinkxcoshk(h+z)sin\sigma t$.....(9)

Using (9), $u = \frac{coshk(h+z)}{coshk(h+\eta)}u_\eta$, then integration in (7) becomes,

$$\frac{\partial}{\partial x}\int_{-h}^{\eta}udz = \frac{\partial}{\partial x}\int_{-h}^{\eta}\frac{coshk(h+z)}{coshk(h+\eta)}u_\eta dz$$

Completing the integration will obtain

https://dx.doi.org/10.22161/ijaers.69.16 *ISSN: 2349-6495(P) | 2456-1908(O)*

$$\frac{\mathrm{d}}{\mathrm{d}x}\int_{-h}^{\eta} udz = \frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{u_\eta tanhk(h+\eta)}{k}\right)$$

From the wave-number conservation equation (Hutahaean (2019a)), $tanhk(h+\eta) = tanhk_0(h_0+\eta_0) = 1$, where$k_0$is wave number in deep water, $h_0$is deep water depth and$\eta_0$is water surface elevation in deep water, can have a value of $\frac{A_0}{2}$or others, $A_0$is wave amplitude in deep water. Therefore, the result of the integration becomes,

$$\frac{\mathrm{d}}{\mathrm{d}x}\int_{-h}^{\eta} udz = \frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{u_\eta}{k}\right)$$

Substitute the result of integration to (7),

$$\left(\gamma+\frac{1}{2}\right)\frac{\mathrm{d}\eta}{\mathrm{d}t} = -\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{u_\eta}{k}\right) - \frac{u_\eta}{2\gamma}\frac{\mathrm{d}\eta}{\mathrm{d}x} \quad .....(10)$$

Equation (10) is a continuity equation that will be used in this researchor water wave surface equation in the form of differential equation. In (10), there is wave number $k$parameter that should be known, and some other characteristics that should also be known, among other is deep water depthd_0, i.e. maximumwater depth if the equation was done in water depth $d$which is bigger than d_0, so the calculation is done using d_0.Next is wave amplitude maximumA_{max}, i.e. maximum amplitude in a wave period that can be inputted to the model.

3.2. The calculation ofA_{max}andd_0.

It's been known that there is a relation between water depth $d$and wave number k, then the calculation will be easier if in (10) wave number $k$is substituted with water depth d. Whereas the equation for wave number in deep water $k_0$can be calculated using the following equation, the formulation of an equation outside the scope of this research, will be written in the next paper.

$$\gamma\left(\gamma+\frac{1}{2}\right)\sigma^2 = gk_0(1-k_0A_0) \quad .....(11)$$

$A_0$is wave amplitude which is an input, $k_0$is deep water wave number, σ is angular frequency, $\sigma = \frac{2\pi}{T}$, $T$is wave period. $k_0$in(11) can be calculated using simple calculation, i.e. finding the root of the quadratic equation. (11) can be completed if determinant $D = g^2 - 4gA\gamma\left(\gamma+\frac{1}{2}\right)\sigma^2$is bigger than or the same as zero.In case of $D = 0$,obtains

$$A_{0,max} = \frac{g}{4\gamma\left(\gamma+\frac{1}{2}\right)\sigma^2} \quad .....(12)$$

In deep water $tanhk_0\left(d_0+\frac{A_0}{2}\right) = 1$ applies. Assuming that wave amplitude is much smaller than deep water depth, or $\frac{A_0}{2d_0} \ll 1$, A_0 deep water wave amplitude andd_0 deep water depth, then the following relation applies

$$tanhk_0\left(d_0+\frac{A_0}{2}\right) = tanhk_0d_0\left(1+\frac{A_0}{2d_0}\right)$$
$$= tanhk_0d_0 = 1$$

$k_0$is wave number in deep water depth d_0. As deep water the following criteria is used

$$k_0d_0 = 1.7\pi \quad .....(13)$$

where$tanh1.7\pi = 0.999954 \approx 1$, the uses of this $1.7\,\pi$value is also based on the review of the produced breaker depth. $k_0$was obtained from (11), therefore$d_0$can be calculated using (13).

Bases on wave number conservation equation (Hutahaean (2019a)), the relation between wave number $k_d$in a depth d, with wave number in deep water is,

$k_d(h+\eta) = k_0(d_0+\eta_0)$. Assuming that $\frac{\eta_0}{d_0} \ll 1$, then $k_d(h+\eta) = k_0d_0 = 1.7\pi$ .Or,

$$k_d = \frac{1.7\pi}{(h+\eta)} \quad .....(14)$$

3.3. The Final Water Wave Surface Equation

By substituting (14) to (10), the final water wave equation was obtained with water depth $d$as its parameter, i.e

$$\left(\gamma+\frac{1}{2}\right)\frac{\mathrm{d}\eta}{\mathrm{d}t} = -\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{u_\eta(d+\eta)}{1.7\pi}\right) - \frac{u_\eta}{2\gamma}\frac{\mathrm{d}\eta}{\mathrm{d}x} \quad .....(15)$$

Therefore. There is no need to calculate wave number k.

An example of the calculation of deep water wavelength $L_0 = \frac{2\pi}{k_0}$, deep water depth $d_0$and$A_{0,max}$where $\gamma = 2.000$is used is presented in Table (1) below.

Table.1: The value of $A_{0,max}$, $d_0$andL_0

T (sec.)	$A_{0,max}$ (m)	d_0 (m)	L_0 (m)	$\frac{d_0}{L_0}$
6	0,447	4,929	5,798	0,85
7	0,608	6,708	7,892	0,85
8	0,794	8,762	10,308	0,85
9	1,005	11,09	13,047	0,85
10	1,241	13,691	16,107	0,85
11	1,502	16,566	19,489	0,85
12	1,787	19,715	23,194	0,85
13	2,098	23,137	27,221	0,85
14	2,433	26,834	31,569	0,85
15	2,793	30,804	36,24	0,85

https://dx.doi.org/10.22161/ijaers.69.16 *ISSN: 2349-6495(P) | 2456-1908(O)*

IV. MOMENTUM EQUATION

Weighted total acceleration equation is done in Euler momentum equation in horizontal-$x$direction and vertical-$z$direction consecutively (Anderson (1995)),

$$\gamma\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+w\frac{\partial u}{\partial z}=-\frac{1}{\rho}\frac{\partial p}{\partial x} \quad .....(17)$$

$$\gamma\frac{\partial w}{\partial t}+u\frac{\partial w}{\partial x}+w\frac{\partial w}{\partial z}=-\frac{1}{\rho}\frac{\partial p}{\partial z}-g \quad .....(18)$$

(18) is written as an equation for $p$andthe nature of irrotional flow was performed i.e.$\frac{\partial w}{\partial x}=\frac{\partial u}{\partial z}$, the equation is integrated to vertical-z axis, surface dynamic boundarycondition is performed, i.e. $p_\eta=0$, and differentiated against horizontal-x axis.

$$\frac{1}{\rho}\frac{\partial p}{\partial x}=\gamma\frac{\partial}{\partial x}\int_z^\eta\frac{\partial w}{\partial t}dz+\frac{1}{2}\frac{\partial}{\partial x}\left(u_\eta^2+w_\eta^2\right)$$
$$-\frac{1}{2}\frac{\partial}{\partial x}(u^2+w^2)+g\frac{\partial\eta}{\partial x}\ldots..\ (19)$$

In (17) the nature of irrotional flow was performed, i.e. $\frac{\partial u}{\partial z}=\frac{\partial w}{\partial x}$, and substitute (19) to the right side of the equation,

$$\gamma\frac{\partial u}{\partial t}=-\gamma\frac{\partial}{\partial x}\int_z^\eta\frac{\partial w}{\partial t}dz$$
$$-\frac{1}{2}\frac{\partial}{\partial x}\left(u_\eta^2+w_\eta^2\right)-g\frac{\partial\eta}{\partial x}\ldots..(20)$$

The solution of $\frac{\partial}{\partial x}\int_z^\eta\frac{\partial w}{\partial t}dz$is done using velocity potential (8), where the particle velocity in horizontal direction is in equation (9). Particle velocity in vertical-z, is

$$w=-\frac{\partial\Phi}{\partial z}=-Gksinhk(h+z)coskxsin\sigma t$$
....(21)

$$\frac{\partial w}{\partial t}=-Gksinhk(h+z)\sigma coskxcos\sigma t \quad .....(22)$$

(22) is integrated against time t

$$\int_z^\eta\frac{\partial w}{\partial t}dz=$$
$$-G\left(coshk(h+\eta)-coshk(h+z)\right)$$
$$\sigma coskxcos\sigma t$$

Differentiated against horizontal-x axis

$$\frac{\partial}{\partial x}\int_z^\eta\frac{\partial w}{\partial t}dz=$$
$$Gk\left(coshk(h+\eta)-coshk(h+z)\right)$$
$$\sigma sinkxcos\sigma t$$

Equation (9) is differentiated against time t, $\frac{\partial u}{\partial t}=Gksinkxcoshk(h+z)\sigma cos\sigma t$, which shows that this form is in $\frac{\partial}{\partial x}\int_z^\eta\frac{\partial w}{\partial t}dz$, so the following relation is obtained

$$\frac{\partial}{\partial x}\int_z^\eta\frac{\partial w}{\partial t}dz=\frac{\partial u_\eta}{\partial t}-\frac{\partial u}{\partial t}$$

Substitute this equation to (20),

$$\frac{\partial u_\eta}{\partial t}=-\left(\frac{1}{2}\frac{\partial}{\partial x}\left(u_\eta^2+w_\eta^2\right)+g\frac{\partial\eta}{\partial x}\right)\frac{1}{\gamma} \quad .....(23)$$

(23) is surface momentum equation that produces surface velocityu_η. By completing $\frac{\partial}{\partial x}\int_z^\eta\frac{\partial w}{\partial t}dz$with the method above, then in the momentum equation there is an influence of continuity equation or momentum equation that was produced and controlled by continuity equation. Another control by continuity equation on momentum equation is on variablew_η , i.e.$w_\eta=\gamma\frac{\partial\eta}{\partial t}+u_\eta\frac{\partial\eta}{\partial x}$where$\frac{\partial\eta}{\partial t}$is obtained from continuity equation. Therefore, momentum equation (20) is controlled by water surface equation.

V. RESULT OF THE MODEL

5.1. Numerical Solution

In this research, water surface equation and momentum equation are done with finite difference method for spatial differential, whereas time differential is done using predictor-corrector method based on Newton-Cote numerical integration (Abramowitz (1972)). Whereas the predictor-corrector method is as follows. As an example water surface equation (15) will be done. The water surface equation can be written in the form of,

$$\frac{\partial\eta}{\partial t}=F(t)$$
$$F(t)=-\frac{1}{\left(\gamma+\frac{1}{2}\right)}\left(\frac{\partial}{\partial x}\left(\frac{u_\eta(d+\eta)}{1.7\pi}\right)+\frac{u_\eta}{2\gamma}\frac{\partial\eta}{\partial x}\right) \quad .....(24)$$

The equation is integrated against time from $t=t-\delta t$until $t=t+\delta t$, where the integration of the right side of the equation is done with Newton-Cote numerical integration with 3 (three) integration points,

$$\int_{t-\delta t}^{t+\delta t}\partial\eta=\int_{t-\delta t}^{t+\delta t}F(t)dt$$
$$\eta^{t+\delta t}=\eta^{t-\delta t}+\delta t\left(\frac{1}{3}F^{t-\delta t}+\frac{4}{3}F^{t}+\frac{1}{3}F^{t+\delta t}\right)$$
....(25)

$F^{t+\delta t}$is unknown number, therefore it needs to be predicted using Taylor series and finite difference method, where the step is called predictor step, i.e.

$$F^{t+\delta t}=F^{t}+\delta t\left(\frac{F^{t}-F^{t-\delta t}}{\delta t}\right) \quad ....(26)$$

Substitute (26) to (25), the value of $\eta^{t+\delta t}$prediction can be calculated. With similar way, momentum equation is done, and $u_\eta^{t+\delta t}$prediction is obtained. With those prediction values,$F^{t+\delta t}$can be calculated with (24), and (25) is done. This step is called corrector step. This corrector step is also

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done on momentum equation interchangeably with the water surface equation, and repeated until a convergence is reached where $\left|\eta_{new}^{t+\delta t} - \eta_{old}^{t+\delta t}\right| \leq \varepsilon$and$\left|u_{\eta,new}^{t+\delta t} - u_{\eta,old}^{t+\delta t}\right| \leq \varepsilon$where$\varepsilon$is a very small positive number as an iteration accuracy criteria. Generally, a convergence is reached with 5 iterations.

5.2. The Result of Model Execution

a. In constant depth of 11.0 m

In this section the model is done in a channel with a constant water depth of $d = 11.00$ m, with wave period of 8 sec., wave amplitude $A_0 = 0.794$ m, where actually that does not mean that wave height is twice that of wave amplitude, Hutahaean(2019 c).Deep water depth for this wave is $d_0 = 8.762$m. In the case that $d$is bigger than$d_0$then the calculation of$(d + \eta)$in (15),$(d_0 + \eta)$ is used. The model is done using two boundary conditions, i.e. closed-end boundary condition where horizontal velocity$u = 0$, whereas in the opened-endthe model was given an input, i.e. sinusoidal wave$\eta_0 = A_0 sin\sigma t$. The input is done only for 1 time wave period.

The result of the execution for 8, 24, and 40 sec. is presented in (Fig.2.). In the execution for 8 sec., the wave profile is still in the form of sinusoidal, but the wave trough elevation is smaller than the elevation. In the execution for 24 sec, the formed wave trough is getting smaller and farther away, similarly with execution for 40 sec, the wave trough is getting smaller and farther away where water ripple is formed and the form of the main wave is a perfect cnoidal wave or more accurately it is called solitary wave.

As a conclusion of the model execution in this constant water depth is that in the deep water, the equation used produced perfect cnoidaltype wave or also can be called as solitary wavetype, even though the input of sinusoidal wave, the wave trough part disappears.

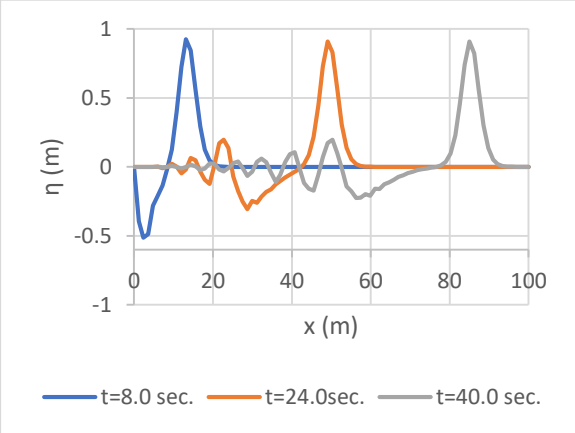

Fig.2.Wave profile after the execution for 8,24 and 40 sec.

b. In a changing depth

With the phenomenon of the evolution of sinusoidal wave into cnoidal wave, in the model execution at the an uneven bottom, before the wave enters the water with slopping bottom, the wave is given evolution zone, i.e. in front of the water in the form of water with constant depth.

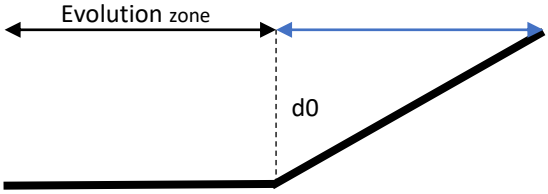

Fig.3. Sea bed for model execution at uneven bottom.

The calculation is done with evolution zone length of 100 m (Fig.3) with constant water depth of$d = 11.0\,m$, then the water depth changes until the depth of 1.0 m, with a distance of 200 m, with tangent of bottom slope i.e. $\frac{dh}{dx} = \frac{10}{200} = 0.05$. The wave used here is wave with wave period 8 sec., wave amplitude 0.794 m, with the result of calculation shown in Fig.4. and Fig.5.Coming out of the evolution zone, shoaling occurs followed by breaking, with a breaker height $H_b = 1.546$ m, at breaker depth $h_b = 1.969\,m$, where $\frac{H_b}{h_b} = 0.785$. This condition is obtained by multiplying the second term of the water wave surface equation (15) with a factor of 2.5, so that (15) becomes,

$\left(\gamma + \frac{1}{2}\right)\frac{\partial \eta}{\partial t} = -\frac{\partial}{\partial x}\left(\frac{u_\eta(d+\eta)}{1.7\pi}\right) - \frac{2.5u_\eta}{2\gamma}\frac{\partial \eta}{\partial x}$.

This coefficient 2.5 is obtained by experimentation in order to obtain $\frac{H_b}{h_b}$approximates 0.80. Coefficient 2.52 can also be used where $\frac{H_b}{h_b} = 0.81$was obtained but the equation becomes unstable after the breaking. Therefore, further research is still needed on water wave surface equation as well as momentum equation that was used.

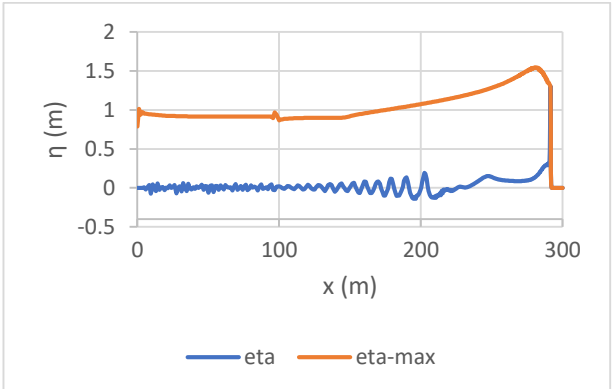

Fig 4. Wave profile (η) and wave crest elevation(η_{max})

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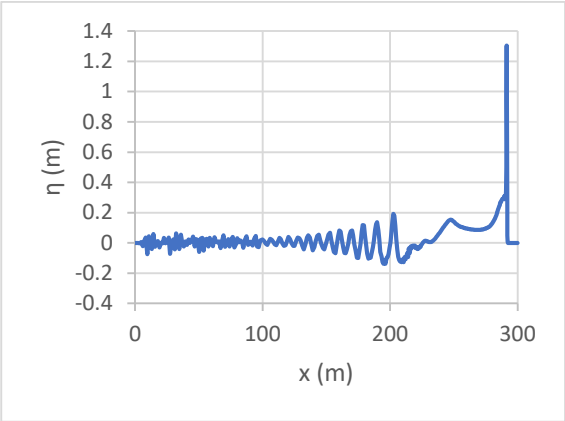

Fig 5. Wave profile (η) after breaking

VI. CONCLUSION

As has been shown that model can produce two main phenomena that occur at the water wave on its way to shallow water, i.e. shoaling and breaking. At the deep water, at a constant depth the profile of perfect cnoidal wave is formed which is also called solitary wave. Behind the main wave, wave ripple is formed which is also known as undular wave. Therefore, it can be said that the equation that was produced in this research can model several phenomena at water wave found in the nature.

Further research that needs to be done is to study the phenomenon at the equation by producing analytical solution. Considering the simple form of the equation, the analytical solution of the water wave surface equation can be obtained easily, i.e. using velocity potential equation from Laplace solution equation. By studying analytical solution, it is expected that an explanation will be obtained on the appearance of coefficient 2.5 at the second term of the water wave surface equation.

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https://dx.doi.org/10.22161/ijaers.69.17 ISSN: 2349-6495(P) | 2456-1908(O)

Social Technologies and living with semiarid: A relationship between the States of Alagoas and Sergipe / Brazil

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Abstract *— The present work aims to map the Social Technologies used to live with the semiarid in the states of Alagoas and Sergipe, since both states are areas characterized by water insufficiency, and these technological innovations have been presented as conditions that help in the social improvement and water sustainability. The methodological procedures adopted were documentary analysis of reports presented by public and private agencies and entities that have works and actions in the implementation of the TS in the municipalities affected by drought. Studies show that in the Alagoas semiarid there is a higher concentration of social technologies deployed in relation to the Sergipan semiarid, being the plate cistern, polyethylene cistern, boardwalk cistern and dams the technologies most used by the population that aims to improve the quality of life and that ensures water sustainability.*

Keywords *— **drought, technological innovations, water sustainability.***

I. INTRODUCTION

In the Brazilian semi-arid region, the low availability of water has been an obstacle to the permanence of families in rural areas [1]. Environmental changes are often imposed by the action of the capitalist system, directly affecting the sustainability of the natural resources and of the societies that depend on them [2].

The search for alternatives or social improvements has become a challenge for social organizations [3]. The use of social technologies has positively impacted social development, focusing on the human factor, due to the involvement of different social actors, and promotion of the dialogue of knowledge, for the realization of efficient solutions where they are developed or reapplied [4].

Life parameters, disabilities and options are numerous in each culture [5]. Therefore, social technologies are their own methodological procedures that respond to the solution of a collective problem of a particular region or community [6].

The necessity of the implantation of technological innovations can help in the water sustainability, being the Social Technologies innovative strategies that allow the country people to live with the semiarid. Therefore, this paper aims to identify the use of social technologies implemented in the semi-arid states of Alagoas and Sergipe, since both have proportional and similar water deficiencies, as well as located in northeastern Brazil, covering the region and the semi-arid climate.

II. THEORETICAL REFERENCE

India is considered the cradle of Social Technologies (TS) in the nineteenth century, where the thought of the reformers of that society was focused on the rehabilitation of traditional technologies, practiced in villages as a strategy to fight British rule [7].

To help the country find alternatives that would lessen British economic dependency, Mahatma Gandhi created the movement that would coin the concept of appropriate technology, which deals with a process of diffusion of technologies from developed countries to developing countries, lowering costs. And the need for investments,

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enabling the development of local industry and agriculture [8].

Gandhi argued that all technology should be contextually "appropriate" in an integrated approach to local social, economic and cultural development [9].

Appropriate Technology was important in order to provoke a deeper discussion about the impact of technologies and their innovations on human life and the planet itself, regarding the relation of production, consumption and exclusion [10]. Other denominations were considered important for their consolidation: Intermediate Technologies, Alternative Technologies, among others [11].

Social technology was introduced in Brazil in the mid-1970s and made public policy since 1981, by the National Council for Scientific and Technological Development, through the Appropriate Technology Transfer Program, which was renamed Social Technology [12].

Although there are several discussions about the concept of Social Technologies, they refer to the set of techniques, transformative methodologies that can be developed or applied in interaction with or even appropriate to the population, and that represent solutions for social inclusion and improvement of living conditions [13].

The Banco do Brasil Foundation [14] corroborates by defining that Social Technology comprises replicable products, techniques or methodologies, developed in interaction with the community and that represent effective solutions for social transformation.

Social Technologies are sustainable local development strategies, as they can favorably affect the living conditions of the communities where they are implemented [15].

Social technology is considered a means of empowerment, defined by products, techniques or methodologies that can be reapplied, developed in interaction with the community and that represent effective solutions for social transformation [16].

It is clear that social technology must include the participation of communities in their process of creation, development and implementation, as well as focus their most relevant needs and be in line with their values, habits and practices [17]. These technologies have played a dual role in contributing to the social and human development of the communities where they are carried out [18].

Proper use has the potential to facilitate the achievement of sustainable development goals, but it can also increase existing social disparities or ecological vulnerability when inadequate in context [19].

III. MATERIALS AND METHODS

In the bibliographic research were used as sources institutional and academic websites, articles, dissertations, theses and booklets that addressed the use of social technologies in the semiarid.

The documentary analysis was carried out through study and search in databases, and also in loco in some departments that developed joint works to the semiarid. The selected institutions are directly involved in the implementation of technological innovations that capture rainwater storage, which made available the reports and the use of the database. Like the Secretaries of State, the Brazilian Semiarid Articulation (ASA), the São Francisco and Parnaíba Valleys Development Company (CODEVASF), the Water Resources Development and Sergipe Irrigation Company (COHIDRO) and the Development Consortium of the Ipanema Region (CONDRI).

The identification of the use of social technologies implemented in the municipalities of the semiarid region of Alagoas and Sergipe was carried out through data collected from November 2018 to June 2019, which were tabulated in Microsoft Excel software and with the help of AQGIS, can be distributed in frequency according to your geographical location.

The technical visits were conducted from May to August 2019, to record and understand the operation of technologies as a strategy for living with the semiarid. The municipalities visited in Sergipe were Poço Redondo and Porto da Folha, and in the state of Alagoas were the municipalities Olho d'Água das Flores, Palestine, Sugar Loaf and São José da Tapera.

IV. AREA CHARACTERIZATION

The Alagoas semiarid has a territorial extension of 12,686.86 km2, 38 municipalities, and a population estimated by the IBGE in 2005 of about 838,740 inhabitants, relatively high demographic density [21]. Sergipe has 11,175.64 km2 of territorial area, 29 municipalities, and a population of 396,399 inhabitants, being considered the smallest state of the Brazilian Federation [20] (FIGURE 1).

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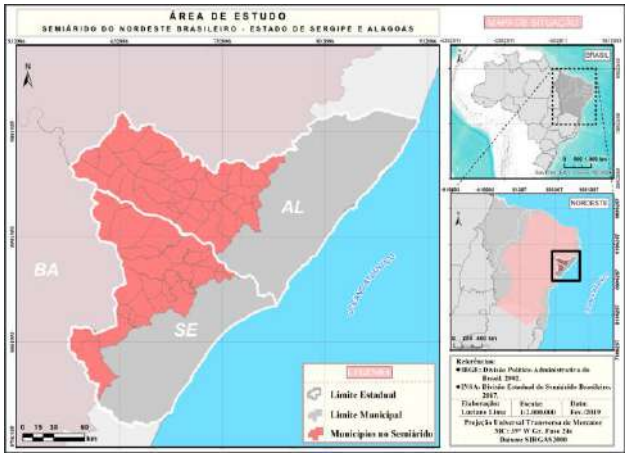

Fig. 1: Geographic localization of the municipalities that make up the semiarid region in the states of Alagoas and Sergipe

V. RESULTS AND DISCUSSIONS

The main proposal of social technologies implemented in the semiarid region aims to solve the problem of water deficiency caused by drought, and these innovations are responsible for capturing and storing rainwater and ensuring the water sustainability of the population throughout the year.

In the mapping of TS, it was identified that the most used by the countryman were the Dairy Cistern (a), Boardwalk Cistern (b), Household Cistern (c), Flood Cistern (d), Polyethylene Cistern (e), Desalination (f), Dam (g), Underground Dam (h), barrier Trench (i) and Stone Tank (j) (FIGURE 2).

The dairy cistern (1a) is a technology used to capture rainwater through the sheepfold roof. Its main purpose is to store the water in a cistern interconnected with the sheepfold and to supply the need for water shortages especially during the dry season.

Fig. 2: Social Technologies implanted in the AL and SE semiarid.

The Boardwalk Cistern captures (1b) all rainwater through a sidewalk and is connected by piping that directs the water to be stored in a cistern that provides 52,000 liters of water for families to use during the drought period to enable the production of vegetables, fruit trees and small animal husbandry, and also improve the quality of food of these families, as it can enable the generation of income by selling the surplus, expanding its possibilities in the agricultural sector [21] .

Plate cisterns (1c) capture rainwater through the roof of the residence [22]. It is made of mortar slabs, and two thirds of the cistern is buried in the ground, which helps to counteract the internal water pressure, giving stability to the walls [23].

Flood cistern (1d) is a social technology that closely resembles the boardwalk cistern, and all water stored in the cistern comes from runoff, whose purpose is to contribute to the guarantee of food and nutritional security through the production of agroecological food. With the flooded cistern it is possible to store rainwater and not let it evaporate, to ensure water for small animals during the dry season and to take it to the homes of farming families for food production [24].

The polyethylene cistern (1e) has the capacity to accumulate 16,000 liters of water, installed on the ground, close to the households in rural areas. It is a clean and ecological technology, since the raw material has good performance and durability, is non-toxic, odorless, waterproof and of good resistance [25].

Desalination is a process carried out by technology called desalination (1f) that involves the transformation of brackish water into drinking water.

Dams (1g) are small reservoirs of about 3,000m³, intended for storing rainwater; Its purpose is to enable watering in critical periods of rainfall irregularity, in case water is lacking, for example, during the initial development of the plant or in flowering [26].

Underground dams (1h) are total or partial flow sealing devices built across the alluvial valleys to intercept subsurface runoff. Underground dam [...] is a water structure that aims to intercept the flow of surface and underground water through an impermeable septum (plastic tarp, wall of stones or compacted clay, etc.)[27], which serves as a technological alternative for the use of rainwater, avoiding erosion to the soil surface, where they can cause erosion, and cannot be used later [28].

The trench barrier (1i) also called “caxio” consists of an open reservoir [29]. Trench barriers are long, narrow, deep tanks that are dug into the ground. This social technology takes advantage of soil impermeability in the semiarid for rainwater harvesting and storage.

The cauldron or stone tank (1j) is a natural cave, excavated in slabs, which represents an excellent reservoir

https://dx.doi.org/10.22161/ijaers.69.17 *ISSN: 2349-6495(P) | 2456-1908(O)*

for storing rainwater for human, animal and agricultural use [30].

It is noticed that social technologies are related to local public policies, and the common characteristics between both are: meeting the demands of society; stimulate social interactions; promote sustainable development; involve public and private social actors; strengthen social and political participation; provide social inclusion through the generation of work and income [31].

The municipalities of Canapi, Girau do Ponciano, Poço das Trincheiras, Santana do Ipanema and Igaci, all from the semi-arid state of Alagoas, had the highest frequency of deployed technologies, ranging from 3.80% to 5.45%. % of other municipalities. It is believed that they stood out for having the territory affected by drought, water scarcity, larger territorial area, high population coefficient, and large losses of agricultural crops, but mainly that there was great influence of public policy actions related to technologies and strategies. water security in the region (FIGURE 3).

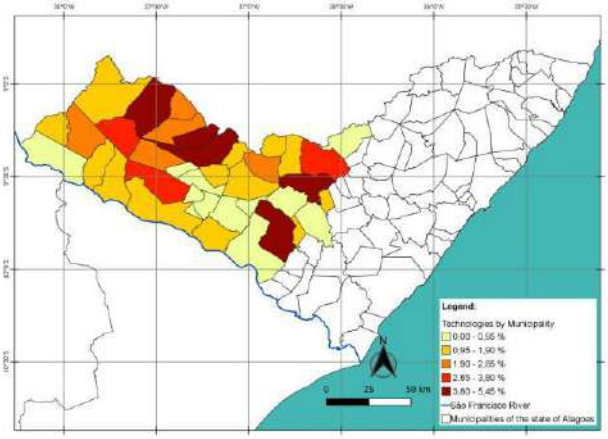

Fig. 3: Distribution of social technologies in the semiarid region of Alagoas.

In the state of Sergipe, the reality is not in opposition to that of the state of Alagoas, with the municipalities of Poço Redondo, Tobias Barreto and Simão Dias presenting the most prominent social technologies. Since these municipalities have as their main feature the low incidence of rain and a water deficit during most of the year, justifying the need to implement these instruments and effective strategies to mitigate and ensure the food security of the population (FIGURE 4).

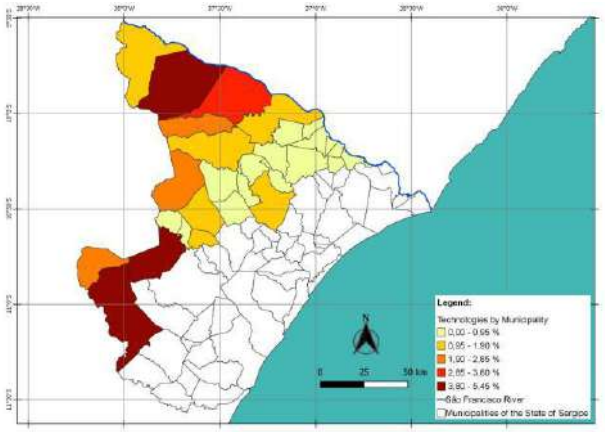

Fig. 4: Distribution of social technologies in the semiarid region of Alagoas.

Amparo do São Francisco is the only municipality in the state of Sergipe that has not been found in any of these deployed technologies, a fact justified by its territorial size, and by having water supply system throughout its territory.

In this sense, [32], presents that the use of social water technologies aims at food production and also help to reverse the negative situation of poverty and misery built on the semiarid region, social technologies aimed at the management of productive resources have led to a significant improvement in household food and nutritional security levels.

Of the 38 municipalities that make up the Alagoas semiarid, the home cistern, the polyethylene cistern, the dam, the boardwalk cistern and the sheepfold cistern predominate throughout the Alagoan semiarid (FIGURE 5). The region of Ipanema stands out for presenting the folding cistern as the main alternative to live with the Alagoas semiarid, social technology not found in the other municipalities surveyed.

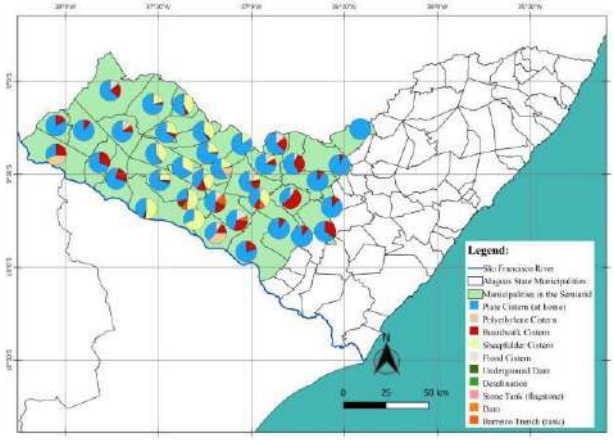

Fig. 5: Mapping of social technologies in the semiarid region of Alagoas.

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In the state of Sergipe, this representation does not differ greatly, being the plate cistern, the polyethylene cistern, the boardwalk cistern and the dam that are most representative and help in living with the semiarid (FIGURE 6).

These technologies, in addition to providing water for families, bring the feeling of comfort, dignity and independence of the public power supply, representing a relief during drought periods.

The TS presented here are excellent tools to ensure access to quality water, as well as improving the quality of life in rural communities, as social technologies enable the countryman to develop activities such as animal husbandry and agricultural production with the possibility of marketing the products.

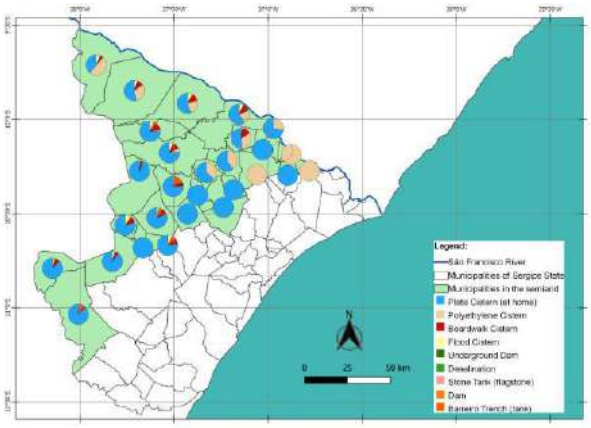

Fig. 6: Mapping of social technologies in Sergipe semiarid.

The State of Alagoas presented higher concentration of TS implanted in the Alagoas semiarid, a percentage of 68.81%, this result may be related to the number of people living in the Alagoas semiarid being higher than the Sergipan semiarid. The frequency distribution presented in the Sergipan semiarid was 31.19% of ST implanted in the studied municipalities (FIGURE 7).

All the predominant social technologies were implemented in the semiarid region of Alagoas, except for the trench barreiro, although existing in some municipalities in Alagoas, this technology only stood out in Sergipe state. This fact can be explained by the geological formation of the surface being favorable to crystalline subsoil regions, as in Sergipe, but the same does not happen in subsoil regions of sediments such as limestone and sandstone, because the water accumulated in shallow reservoirs gradually infiltrates and significantly reduces the amount of water stored in a short time [33].

The plate cistern is responsible for 38.02% of the TS implanted in the state of Alagoas, while the state of Sergipe presented a percentage of 22.75% (FIGURE 7).

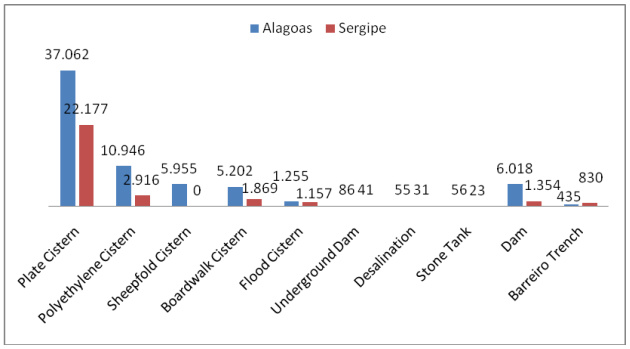

Fig. 7: Comparison of Social Technologies implemented in the semi-arid states of Alagoas and Sergipe.

The smallest TSs outside 0.13% underground dams, the desalination plants (0.08%) and the stone tank (0.08%), these low percentages are related to the natural and operational problems of their implementation.

Difficulties in the implementation of underground dams include the type of soil suitable for the construction of the system, impervious sites to prevent infiltration and distancing with the sewage system. The main reason for desalination was the fact that it required a large financial investment for its installation and maintenance, and finally the stone tank because it depends on the geological formation of the land to use it.

Highlight the advantages of using social technologies, because the low investment and capital cost for each tank produced can create jobs in the construction of these technologies, as well as small-scale organizational simplicity, facilitating the process of adaptability to the socio-cultural environment, generating economic development, local and regional self-sufficiency through the use of natural resources and the practice of social control [34].

VI. CONCLUSION

Both states located in the northeast region of Brazil are affected by a natural factor, water insufficiency, which generates negative consequences for the population, social technologies are innovative alternatives that enable the population to live with the semiarid.

The application of these technologies broadens the development prospects, as they are mechanisms that enable access to quality water, whose main purpose is to improve the population's quality of life.

The State of Alagoas presented a higher concentration of implemented social technologies aimed at water sustainability compared to the State of Sergipe, perhaps due to its higher population concentration in the semiarid.

Among the technologies most used by states are technologies that are easier to deploy and maintain. Thus, it is clear that the use of these technologies ensures access

https://dx.doi.org/10.22161/ijaers.69.17 *ISSN: 2349-6495(P) | 2456-1908(O)*

to quality water, in addition to contributing to the permanence of the population in the area affected by drought, positively impacting local development.

ACKNOWLEDGEMENTS

This work was carried out with the support of the Higher Education Personnel Improvement Coordination - Brazil (CAPES) - Financing Code 001.

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https://dx.doi.org/10.22161/ijaers.69.18 *ISSN: 2349-6495(P) | 2456-1908(O)*

Forecasting bitcoin pricing with hybrid models: A review of the literature

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Abstract*—The electronic transition has been gaining a large groundin recent decades due to the use of crypto currencies. One of the most popular is Bitcoin. It is open source, the transactions and the issuance of bitcoins occur collectively through the network.The analysis of the behavior of Bitcoin becomes a relevance to the prediction Price and achieve successful investments in it.This review is conducted for the analysis and comparison of the of the different prediction methods focused on the bitcoin price. Anemphasis is placed on those who have a structure as the basis of the ARIMA model, then adding to the hybrid methods, which use neural networks to complete the method.*

***Keywords*—Bitcoin, cryptocurrency, moving average, autoregressive, price prediction.**

Objective. *A review of the literature including ARIMA techniques applied in bitcoin forecasting is presented. A summary of metanalysis findings was prepared and a research agenda of potential further work is defined.*

I. INTRODUCTION

In the last decades, the globalization and the technology brought great changes in several sectors, such as the economy and administration. One of those changes is electronic money, a new payment method. The cryptocurrency is an electronic currency, due it uses cryptographic tests to control the additional units and verify the transfer of assets. (Nakamoto, 2008).

The cryptocurrencies are a peer to peer version of commerce. The main advantage of these transactions is that payments can be sent from one user to another.

Due to the financial crisis of 2008, interest in cryptocurrencies returned. Cryptocurrencies may have the ability to face several problems relevantforfiat currency system, right at the beginning of the global financial crisis [1]. In fact, Bitcoin was born as a decentralized network and as a digital currency. Internet users split it by using a B to refer to the network.

Bitcoin technology uses cryptographic tests in its software to process transactions and verify the legitimacy of bitcoins and distributes the processing work among the network [2]. This was developed to avoid using trusted third parties, such as bank and cards.

At first Bitcoin operations, it was possible to make payments in the internet without restraint, and without the costs of central authorities. This allows the behavior of bitcoin as an analogy of assets transference, retaining its value by itself. At the same time, the bitcoin achieves the economic definition of money: it is a mean of Exchange, unit of account and storage of value. [1].

II. PREDICTION TECHNIQUES

2.1 Autoregressive Integrated Moving Average (ARIMA).

The autoregressive integrated mobile average (ARIMA) is the most common and widely used time series model. Due to its statics properties this model is very important. [3].

This tool can develop several exponential smoothing models and could work in some types of time series, without losing the original characteristics or the time series.

The ARIMA model approach outperforms pure autoregressive series (AR), pure moving averages (MA) and combined AR and MA (ARMA) series models. An important lack of scope of these individual techniques is that they presuppose that the time series are linear (Zhang, 2003).

Using the linear model in the real world, complex processes cannot be represented and have successful results. The ARIMA model has an advantage, this model has individual components that describe trend, error and seasonality separately (p, d, q). That is why nonlinear models can be represented.

https://dx.doi.org/10.22161/ijaers.69.18 *ISSN: 2349-6495(P) | 2456-1908(O)*

2.2 Recurrent Neural Network (RNN)

Neural networks predict the data of an observation along the spatial dimensions in which they occur. These can model the behavior of the observations due to the different learning they use on the existing data.An important way to deal with modeling complications with observations of erratic behavior is factoring. This translates the obstacle of modeling into a sequence problem. From the previously observed data, the network learns to predict the following data. An expressive sequence model is necessary to model non-linear correlations (Oord, Kalchbrenner, & Kavukcuoglu, 2016).

Recurrent Neural Networks (RNN) have a long history with a good performance in neural networks. Typically used in modeling sequential data such as voice recognition and handwriting.These are powerful tools that offer a compact and shared parameterization of conditional distributions series[4].

The prediction of time series data is considered a major problem in machine learning and artificial intelligence. The objective of statistical modeling of language is to predict the next word in the context of textual data; therefore, it deals with a problem of predicting sequential data when building language models [5]. The recurrent neuronal network (RNN) is a neuronal sequence model that obtains the last data in a specific process. This process includes processes such as language, voice recognition and machine translation [6].

Due to the learning ability of data observations, and non-parametric modeling, RNN becomes a very important complementary method to integrate with classical time series prediction methods such as ARIMA.

2.3 Learning machine (LM)

Machine learning models are specialized methods, developed from monolayer neural networks. One of the applications of learning machines is to analyze time series models. Within this field we can find models such as: Bayesian neural networks, multilayer perceptron, radial-based functions, generalized regression neural networks (also called kernel regression), CART regression trees, neighboring K-closest regression, Gauss processes and support vector regression [7].

III. SEARCHING METHODOLOGY

The development of the filtering methodology and the selection of the research keywords are shown below. The purpose is to give a general description of the focus of this review of the literature. The input method was based on the one developed in the “GAMIFICATION IN HIGHER EDUCATION AND STEM: A SYSTEMATIC REVIEW OF LITERATURE” [8].

1. Objective of the review. Identify keywords and look for question options.
2. Filtering of relevant studies. The selection process began on March 3, 2016 and lasted approximately one month. The academic search service "Web of Science" and "Google Scholar" was used. This to ensure wide coverage, the written keywords were "ARIMA", "Bitcoin" and "Forecasting", looking for title and content fields. The deadline was advanced for 2015-2018. It was not necessary to include consideration of the language, since only documents written in English were found.
3. Selection of works. The filtering process is integrated into a data set of 171 articles. The first step of the selection came from the reading of abstracts, which made discard the first and the largest number of articles.
4. Data graphics. Several characteristics of the studies have been stratified, to obtain an overview for the reader and easily obtain a complete picture of the state of the art. A special approach is made on forecasting efficiency and how is the research behavior on the methods and combination used for this analysis.
5. Organize and report the results. The last stage presents the results of the meta-analysis, highlighting the benefits, limits and problems of each method and approach of the studies.

IV. METANALYSIS

As a result of the literature reviewed, the basic structure of the time series analysis method can be classified. A useful overview of the quantity and type of techniques used in bitcoin price forecasting is shown.

This analysis shows the accuracy of the price prediction methods. It is classified by the method plus another tool. The tool added to the ARIMA model modifies the behavior and skills of the original statistical method.

The literature reviewed shows that most authors begin work with conventional statistical methods for modeling the price of bitcoin. Such as AR, MA, or ARIMA. These tools are used as a starting point for add to neural networks or learning machines.

https://dx.doi.org/10.22161/ijaers.69.18 *ISSN: 2349-6495(P) | 2456-1908(O)*

Table 1. Time series modeling methods used in reviewed literature from 2015 to 2018.

Author	ARIMA	AR	MA	LSTM	RNN	NNETAR	SUTTE	Empirical conditions	IRL
[9]	*								
[10]	*			*					
[11]	*	*	*						
[12]	*				*				
[13]	*					*	*		
[14]			*	*					
[15]	*				*				
[16]	*							*	
[11]	*	*	*						
[17]	*								*

Each method developed in a hybrid manner is not applied to the same study conditions. A crucial condition is the sampling interval. This affects LAG directly. Which allows to observe different behaviors in the closing price of bitcoin.

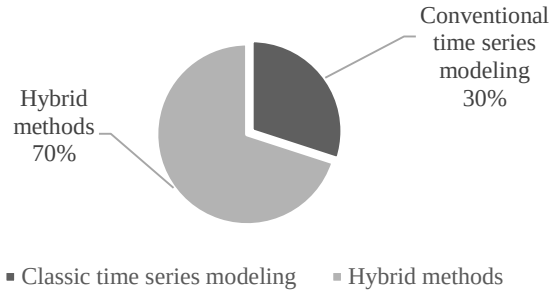

Fig. 1. Comparison between classic and pure statistical methods against hybrid methods which use Artificial Neural Networks.

At first sight, the difference between studies that use conventional statistical methods, 30% of the works being analyzed, against the other 70% are studies that use hybrid methods for the analysis of Bitcoin behavior.

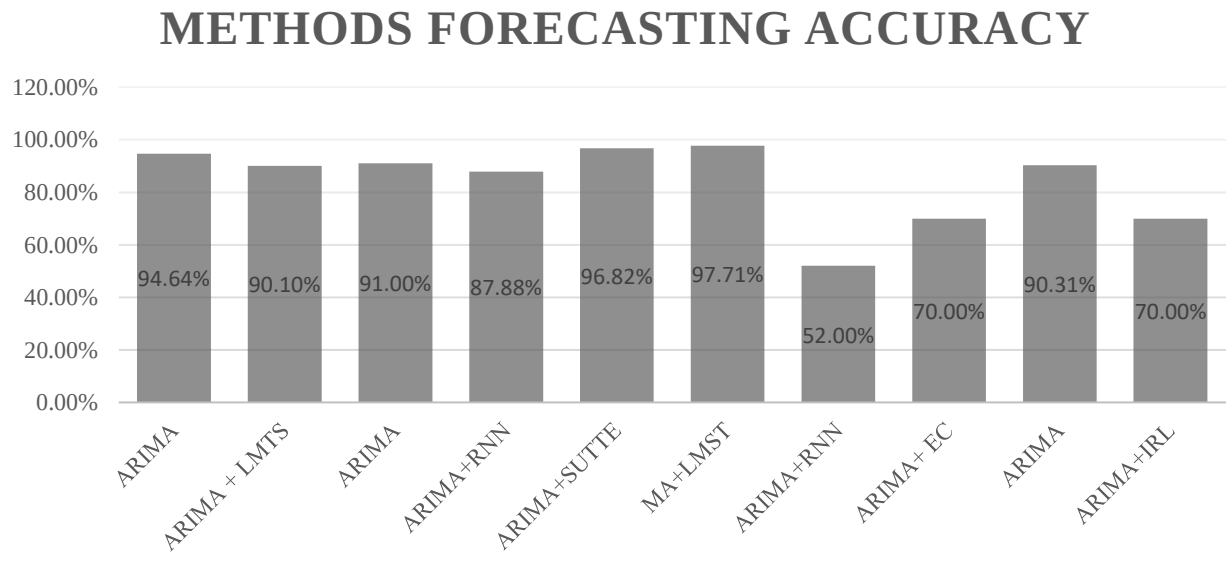

Fig. 2. Comparison of different methods and its prediction of bitcoin price accuracy.

V. DISCUSSION

ARIMA is not, by itself, the best way to model the behavior and prediction of bitcoin prices. The stationary characteristics facilitate the ARIMA modeling process. Therefore, the data is pre-processed to make them

https://dx.doi.org/10.22161/ijaers.69.18 *ISSN: 2349-6495(P) | 2456-1908(O)*

stationary, and then the values (p, d, q) are obtained to find the ARIMA model that minimizes the prediction MSE.

Different research suggests that predicting the price of bitcoin using its closing price history could result in large MSE values. This due to the vulnerability of bitcoin prices to large variations.

The high volatility environment creates a considerable error for the ARIMA model. Therefore, forecasting in a high volatility environment requires special consideration of error diagnoses. The forecasting approach used by the ARIMA method produces a reliable short-term model.

VI. CONCLUSION

The price of bitcoin during the sample period is a non-stationary time series, and the difference sequence cannot verify the specific type. Therefore, the appropriate ARIMA model cannot be found.

LSTM model make a strong framework with time series techniques. It can build an efficient time series prediction model without strict assumptions of data distribution.

LSTM and ANN provide a new forecast framework for bitcoin price prediction.Also becamein tools forseveral behavior analysis. Industry instances such as medical data or financial time series data.

VII. RESEARCH AGENDA

Survey can continue to determine the factors that contribute to the volatility of the bitcoin exchange rate. In the same way the correlation of bitcoin with another currency can be considered as another area to analyze.

Research papers are important for predicting the bitcoin exchange rate in a high volatility environment. This information will help investors make predictions of the bitcoin exchange rate. For the same task, volatility should be monitored for trends and possible causes of this.

VIII. ACKNOWLEDGMENTS

The review would not have been these results without the stimulating contribution of CONACYT, for the financial support provided during the completion of this project with scholarship number 932840. Also want to thank to the Autonomous University of Querétaro for his very valuable support with the master's scholarship.

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https://dx.doi.org/10.22161/ijaers.69.19 *ISSN: 2349-6495(P) | 2456-1908(O)*

Medical plants: from Colonial Brazil to their indication by the National Single Health System – SHS

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Abstract— *Traditional knowledge of medicinal plants contextualizes the history of humanity. Thus, this research aims to analyze the use of medicinal plants in Brazil, addressing the historical aspects, the regulatory framework, and the prospects of proof and indication by SHS. Human kind has always used medicinal plants, described 60,000 years ago B.C. and 5,000 years ago B.C. by Chinese medicine. In Brazil, due to the wide biological diversity of fauna, flora, and traditional communities, it is a historical representation of human interaction with ecosystems. Some naturalists who have traveled throughout Brazil during the Colonial and Imperial periods, resulting in works such as Natural History of Brazil and Nature, Diseases, Medicine and Remedies of Brazilian Indians, have described the reports on the use of plants. The field diaries and drawings produced by the travelers were essential for the development of research. Only in the twentieth century it was possible to perform more complex pharmacological tests, and the regulatory framework governing the production, use, and regularization of medicinal plants was subsequently approved, as well as in the National Program of Medicinal Plants and Phytotherapies, phytotherapeutic drugs were inserted into the treatment of diseases of the Single Health System. The interculturation of traditional knowledge by the different cultures that make up Brazil is a unique factor in the dissemination of phytotherapy present in the national floristic diversity.*
Keywords— ***Medical plants, National Single Health System, SHS.***

I. INTRODUCTION

The ethnobotanical knowledge involves a set of useful plants with multiple utilities, such as ornamental, timber, medicinal, among others (FLORENTINO; ARAÚJO; ALBUQUERQUE, 2007). Medicinal plants are used since the emergence of humankind for presenting therapeutic properties that help in the prophylaxis and cure of diseases, fulfilling an essential role in culture, medicine, and nutrition worldwide, an understanding value associated with the knowledge of traditional communities (ANTONIO; TESSER; MORETTI-PIRES, 2013).

The concept of traditional knowledge was widely defined by Littler (2010, p. 12) as knowledge belonging to indigenous peoples, agro-extractivist populations, quilombolas, riverbank dwellers, and other social groups called traditional. The experience of these communities has a historical, social, environmental, and cultural context such as lifestyle, struggle, and survival of people who have long been marginalized (GRZEBIELUKA, 2012).

Given the socio-cultural aspect, from primitive societies, the Middle Ages, the period of great navigations to the regulation and use by the Single Health System – SHS, there were frequent changes in the way of life, emphasizing the conservation of the use of medicinal plants by traditional communities (ROCHA *et al*., 2015).According to Mota& Dias (2012), the knowledge is passed on orally and may be lost over time; generally, older people are the holders of knowledge about medicinal plants, because there is not always interest among younger people.

In general, there is little appreciation of younger people about the traditional knowledge related to the use of medicinal plants, in this aspect can infer in the loss of this local knowledge (OLIVEIRA; MENINI NETO, 2012). Significantly, there is a systematization of this knowledge, providing inter-scientificity. According to Giraldi & Hanazaki (2010), the use and understanding of medicinal plants is a decisive factor, for giving the strengthening of

https://dx.doi.org/10.22161/ijaers.69.19 *ISSN: 2349-6495(P) | 2456-1908(O)*

local knowledge and direct contact with the flora.

In this sense, the neo-traditional knowledge addressed by Begossi (2000), presents characteristics of relative importance, as well as a baggage of new and emerging experience. That is, the neotraditional knowledge is in constant change, following the process of changes in traditional communities that may culminate in devaluation or gains for local identity.

For Zuchiwschi*et al*., (2010; p 270), traditional knowledge is the contact of humans with natural resources, knowing that it is passed through generations and does not constitute a stabilized body, being particular forms of knowledge construction (CUNHA, 2009), which means that traditional knowledge is timeless, with only its traditional procedures, not the referents (SILVA, 2018).

Traditional knowledge is one of the most critical assets in the construction of the historical, cultural, and political identity of a people (DUTT; BHAGAT; PANDITA, 2015). Each community has a system based on beliefs particular to the local way of life. These principles are involved, because they emphasize a specific historical, environmental, spiritual, and social context, culminating in a diversity of knowledge and modes of relationship with the environment (LITTLE, 2010). The variety of expertise supports thousands of systems that must be studied to be valued.

Baptista (2010) states that public policies try to value cultural diversity, but some communities often insist that only scientific knowledge is valid. The scientific study of cultures is a critical factor for the appreciation of communities, resulting in empowerment and social struggles (SILVA, 2018). These set of knowledge in the field of ethnobotany when scientifically proven its effectiveness, contribute to the appreciation of local culture and ways of life of the population (AMOROZO, 2001).

Human relations with nature make up a system of beliefs and practices, called kosmos-corpus-praxis (k-c-p), the cosmos is related to the operation of ideas and cosmovisions, corpus is the system of systematized knowledge, and praxis is the system of practices and behaviors, in this triad science accepted the dialogue with the existence of other types of experience (TOLEDO; BARRERA-BASSOLS, 2009). The traditional knowledge is a perspective of the relationship of the individual with the environment, configured according to the particularities, needs, and perceptions experienced in community.

The interactions between traditional communities and plants in countries of broad biological diversity such as Brazil is the target of bioprospecting new molecules with pharmacological, agricultural, and industrial applicability (SANTOS, 2012). Concerning the valuation of traditional knowledge, this research has the primary objective of analyzing the use of medicinal plants in Brazil, addressing the historical aspects, the regulatory framework and the prospects of proof and indication by SHS.

II. MATERIALS AND METHODS

This research deals with exploratory, bibliographical, and documentary studies. In general, the sources of research and case studies represent a bibliographic survey on the subject according to Prodanov& Freitas (2013; 51-52). The composition was based on the search for studies indexed in databases such as Scielo, Google Academic, and Science Direct. The consultations to the journals had a chronological cut with timeless delimitation.

The literature review addresses topics related to the use of medicinal plants based on issues, according to reference researchers in the area. Historical aspects of the use of medicinal plants (PETROVSKA, 2012). Medicinal plants in imperial Brazil (DEAN, 1991; DEAN, 1992). Legislation regulating the use of medicinal plants in Brazil (BRAZIL, 2019) and the Policy and Program of Medicinal Plants (BRAZIL, 2019).

From this literature review, it was sought to contemplate official documents of the National Policy and Program of Medicinal Plants and Herbal Medicines, which guide the botanic control, microbiological, chemical, and pre-clinical and clinical trials of the drug[1], to ensure the quality of the final product.

The data were qualitatively verified through content analysis. According to Bardin (2009), the study of the material requires its codification, i.e., the transformation of text data by clippings, aggregation or enumeration, until its codification reaches the representation of the content or its expression.

III. RESULTS AND DISCUSSION

3.1 Historical Aspects of the Use of Medicinal Plants

Throughout the evolutionary process, the relationship of primitive man with floristic biodiversity led to adaptations for survival in the environment, with the domestication of species and knowledge of medicinal potential through experiences and instinctive observations in nature (PETROVSKA, 2012). Over the centuries, the use of medicinal plants is considered one of the oldest practices of humanity as a form of prevention and treatment of diseases from remote times to the use by SHS (FIRMO *et al*., 2012).

Historical data show that from the existence of

[1]Substance or raw material that has medicinal or sanitary purpose (Law nº 5991/73).

https://dx.doi.org/10.22161/ijaers.69.19 *ISSN: 2349-6495(P) | 2456-1908(O)*

primitive societies, men began to cultivate plants with therapeutic and food properties (FRANCO; FERREIRA; FERREIRA, 2011). Contemporary society is formed by the cultural heritage of the Chinese, Babylonians, Assyrians, Hebrews, Greeks, Egyptians, and Hindus among other civilizations that reported the use of medicinal plants (PATWARDHAN *et al*., 2015).

The use of medicinal plants precedes the appearance of writing, and there is no exact date of the first use of these plants. The management of nature for its own benefit is a biological, genetic, evolutionary, and adaptive mechanism, and medicinal plants have been used for the well-being of humankind since the beginning, about 60,000 years B.C. (ROCHA *et al*., 2015). The history of medicinal plants is not only based on experiments over the years but contextualizes the historical aspects of humanity.

The first written evidence of the use of medicinal plants dates back approximately 5,000 years B.C., found in a clay slab in Nagpur Sumer, which contained twelve recipes for the preparation of drugs with more than 250 different plants, some with alkaloid therapeutic potentialities, such as poppy, henbane and mandrake (PETROVSKA, 2012; KELLY, 2009).

Around 2,500 B.C. the Chinese emperor Shen-Nung wrote the book "Pen T'Sao", the paper addressed 365 remedies from the hard parts of medicinal plants, most of which are used until today as *Rheirhizoma*, *Theae folium* and *Podophyllum* (PETROVSKA, 2012). Shen-Nung considered the father of Chinese medicine, for being the holder of the knowledge of poisonous herbs used to worship Pan Ki, the God of Taoist creation (SANTOS *et al*., 2006; FIRMO *et al*., 2012).

With intertwined knowledge, medicinal plants were mystified, and some plants were considered divinities (DUARTE, 2018). In India, the sacred book of the Vedas reported the use of plants to treat diseases in the country (PETROVSKA, 2012). Among the medicinal herbs known worldwide of Indian origin are nutmeg, pepper, clove, and others.

In 1,500 B.C., a record of the use of medicinal plants was found in an Egyptian manuscript called "EbersPapirus", which contained information on 700 drugs and 811 prescriptions, the plant with most prominence was Ginseng (*Panax ginseng spp*), used in the pharmaceutical industry (DUARTE, 2006). These manuscripts consisted of the traditional design for better living conditions and human health.

According to Leite (2009), in Mesopotamia around 2,600 B.C. plants such as *Cedrus sp*. (cedar), *Glycyrrhizaglabra* (licorice) and *Papaver somniferum L*. (poppy) were used as a natural medicine, which is currently used for pathologies known in *Yin-Yang*, one of the most critical natural therapeutic treatments of Chinese culture (PORTELINHA *et al*., 2017).

In Homer, "The Iliad" and "The Odyssey", major epic poems of ancient Greece, written around 800 B.C., mentioned 63 species of medicinal plants used in Assyrian, Mycenical and Egyptian pharmacotherapy, some plants were named with names of mythological characters of these epics, as in honor of Elena, the reason for the Trojan war was called the elecampane (*Inulahelenium L. Asteraceae*) (PETROVSKA, 2012).

Greek mythology also influenced the nomenclature of plants, listing Artemis, goddess of wild nature that means healthy, and naming the plant genus Artemisia, which was trusted to restore energy and improve health (WRIGHT, 2003). The Greek civilization stands out about the use of medicinal plants by the works of Hippocrates (459-370 B.C.), which contain more than 300 plants characterized by physiological action (MOITA, 2015).

Hippocrates, considered the father of medicine and the most famous doctor of antiquity, studied traditional medicine and healing through indications of medicinal plants, discarding supernatural approach to abnormal behavior of the physiological system (DE SOUZA; BAPTISTA, 2017). Greek medicine has changed the way it interprets disease with the health-disease binomial, which considers illness as an imbalance of natural forces that are inside and outside the person (FERNANDES; OLIVEIRA, 2016).

With Christianity, the Holy Bible describes passages in which God created plants and herbs for healing physical illnesses (II Kings 20:7; Psalms 51:7), as well as emotional ones (Genesis 43:11; Psalms 45:8; Song of Songs 2:5). Several biblical passages and the Jewish book Talmud expose the use of aromatic and incense plants during the rituals of treatment of diseases (DIMITROVA, 1999).

The Bible addresses the spiritual and ceremonial issue of healing plants. Thus, during the Middle Ages, knowledge about plant cultivation was assigned to monks who planted around monasteries and churches, usually as food and medicine, whose uses became frequent and effective (FUNDAJ, 2009).

In the 21st century, studies around the world confirm that practices in Complementary Alternative Medicine (CAM) cover a significant percentage in developed countries. In Europe, the MAC has more and more followers, with 75% in France, 70% in Canada and 42% in the USA, with several natural pharmacies (FUNDAJ, 2009; ZENI *et al*., 2017; WHO, 2002). It is estimated that 80% of the world's population uses herbal medicine as an aid in the treatment of diseases together with conventional medicine (WHO, 2002).

https://dx.doi.org/10.22161/ijaers.69.19 *ISSN: 2349-6495(P) | 2456-1908(O)*

In this perspective, the term herbal medicine is the specific adjective that addresses the use of medicinal plants, the same is of Greek origin *phyton*, which means vegetable and treatment therapy, the approach consists of treating diseases with medicinal plants *in natura* or processed in the form of medicines (ALVES; SILVA, 2003).

The history on the use of medicinal plants in remote Brazil the traditional communities that inhabited the Brazilian territory before the period of the great navigations, around the year 1500. However, research to systematize this knowledge began in the colonial period, with the presence of naturalists sent by the crown in the 16thto 19thcenturies (ALVES, 2013).

The first report on Brazilian biodiversity was described on May 1, 1500, by the scribe Pero Vaz de Caminha to the king of Portugal, in which he wrote "the many, infinite waters", reporting the landscape, the trees, some animals and the fertility of the newly discovered land with wealth of detail and admiration (DA COSTA, 2017).

In this letter, the presence of the Indians is something perceived with amazement because it is a new culture with different habits and customs, which in turn knew the local ecosystem. The Indians were described as "strong men" in the sense of being healthy. Before the arrival of the Europeans, the Amerindians exchanged information in the ethnomedical system between cultures. It is estimated that there were about 200 thousand semi-nomadic tribes (BARBOSA *et al*., 2016). Besides, 274 indigenous languages were registered in Brazil (FUNAI, 2019), with 188 remaining (RODRIGUES, 2013).

The new colony was rich in biodiversity, and therefore the king of Portugal prohibited the entry of any other foreigner into Brazil, with the result that for three centuries local research on the biological aspects of flora, fauna, and soil was conducted only by Portuguese or people indicated by them (ALVES, 2013). At that time, the travelers were mainly naturalists, designers, and painters who produced various works.

Gabriel Soares de Souza was one of the main travelers of colonial Brazil, having, in 1569, from his travels through the Brazilian territory, written the book "O TratadoDescritivodoBrasil". It is a work that clearly and meticulously records the geography of the Brazilian coast, its topography, colonization, agriculture, as well as the Indians, flora, fauna, and ethnography, especially in the state of Bahia (GUIMARÃES, 2018). He approached the Brazilian biodiversity with propriety and richness of details, according to the time he lived through.

Other famous travelers of the 17thcentury were the naturalist doctors Guilherme Piso and George Marcgrave, members of Mauricio de Nassau's entourage, who were in Brazil to colonize the northeastern part of Brazil. In this trip, Piso effectively tested several medicinal plants. In 1948, he wrote the first book on herbal treatments called "De Medicina Brasiliensis", Piso, in partnership with Marcgrave, gave rise to the work entitled "Natural History of Brazil" (ALVES, 2013; ROSSA-FERES *et al*., 2017).

Another prominent traveler and naturalist were Grigory Langsdorff, physician, botanist, and head of a Russian expedition on a scientific trip through Brazil, having traveled from Rio de Janeiro to the Amazon region in the first half of the 19thcentury (LUVIZOTTO, 2012). Besides this, we also had Carl Friedrich Phillip von Martius, who wrote the book "Natureza ,Doenças, Medicina e Remédios dos ÍndiosBrasialeiros" in 1844 (SOUZA; HENNIG, 2017).

Auguste de Saint-Hilaire, French explorer, pteridologist, botanist, and mycologist who wrote several works and collected a 30 thousand-specimen herbarium composed of 7 thousand different species of plants (PIGNAL *et al*., 2012). TheodoroPeckolt, naturalist and pharmacist, who together with Gustavo Peckolt, wrote in 1888 the book "Historia das plantasmedicinaes e uteis do Brazil: I" (SIVA *et al*., 2015). These works proved to be indispensable for the study of bioprospection of medicinal plants in Brazil (BERLINCK, 2012).

The scientific and philosophical expeditions developed by the European colonizers are characterized as the first milestone for the use and knowledge of the flora, as well as the general aspects that involve the natural wealth present in the Brazilian territory. From the information of these studies and aware of the profit that the colony could provide, the Portuguese royal court changed to Brazil in 1808, becoming an Empire in 1815 (CONCEIÇÃO; MEIRELLES, 2015).

The influence of European culture in colonial and imperial Brazil disseminated a combination of customs, knowledge, and beliefs, through the fusion of expertise from the sixteenth to nineteenth centuries, influenced socio-economic changes by immigration policies, by the marketing of slaves, agriculture and other forms of development of the time (SIKORA, 2014). For Alves (2013), after the arrival of the Portuguese royal family, the Brazilian biodiversity was studied systematically and scientifically.

In imperial Brazil, the junctions of indigenous, African, and European cultures spread the Brazilian identity. Regarding genetic traits and acquired customs, experiences with ethnozoology and medicinal plants are reported (ALVES, 2013). GrigoryIvanovichLangsdorff was a naturalist who was on expeditions to Brazil in the nineteenth century and headed a journey of over 10,000 km across the national territory (OSSENBACH, 2018).

https://dx.doi.org/10.22161/ijaers.69.19 *ISSN: 2349-6495(P) | 2456-1908(O)*

The German botanist Carl Friedrich Phillip Von Martius, author of the work "Flora Brasiliensis", composed of 15 volumes, had the collaboration of 65 botanists of 10 nationalities (XIMENES; COELHO, 2017). The following researchers began to worry about prospecting factors, as in 1889, the mastic tree (*Schinusterebinthifolius Raddi*), was already studied by Theodoro Peckolt who produced a work suggesting the chemical study of the plant (ALVES, 2013).

The 20thcentury was marked by the work of Mello-Leitão"A Biologia no Brasil", written in 1937. In this work, the author reports the historical aspects of naturalism in Brazil over three centuries; during this period, chemistry made essential advances, especially in the areas of science and anthropology with the foundation of institutions, such as the National Museum, the EmílioGoeldi Museum in the state of Pará and the Paulista Museum (ALVES, 2013).

Since the 2000s, contemporary studies have presented an innovative scenario in the use of herbal medicines, based on ancient and universal aspects in the anthropological knowledge of medicinal plants. According to the Ministry of Health, in 2017, 66,445 phytotherapy consultations were recorded in 1,794 Primary Care facilities, distributed in 1,145 towns (BRASIL, 2018).

3.2 Brazilian legislation on medicinal plants

The incidence of the use of medicinal plants and herbal medicine is part of the historical and social context based especially on oral tradition (BRUNING; MOSEGUI; VIANNA, 2012), being part of the National Program of Medicinal Plants and Herbal Medicines. In Brazil, research in ethnobotany, with emphasis on ethno-pharmacology, has enabled the creation of laws that regulate the control of research from the collection of biological material to the experiments of more advanced laboratories.

Within the scope of the Brazilian legislation on control, use and release of medicinal plants and herbal medicines, Law No. 5991/1973 provides on the Sanitary Control of the Trade of Drugs, Drugs, Pharmaceutical Inputs and Related Products, especially the approach of this law is specific to the Federal Pharmacy Council –FPC, which has conniving responsibility in health care since the primary processes of manipulation of medicines (FPC, 2019).

At the federal level, one of the most impactful and necessary laws to protect Brazilian biodiversity is Law No. 13123/201, which defines standards that address access to genetic heritage and associated traditional knowledge (BRASIL, 2015). Within the scope of floristic biology of plants that have therapeutic properties, this law restricts access to genetic heritage and the country for research in bioprospecting and technological development (VASCONCELOS, 2015).

Also known as the biodiversity framework, the new legislation established rules based on bioethics, aiming to protect Brazilian biodiversity as well as the associated traditional knowledge that is part of the human relationship with environmental and natural resources (CFBio, 2015). Concerning popular culture, this law addresses the obligation to share any economic benefits derived from the reproductive material developed from these studies (VASCONCELOS, 2015).

The Federal Council of Medicine - CFM nº 04/1992 recognizes herbal medicine as a therapeutic method (BARRETO, 2014). Years later, Decree No. 5.813/2006 approves the National Policy of Medicinal Plants and Herbal Medicines (BRAZIL, 2006), a factor that reinforces the insertion of medicinal plants within the Single Health System –SHS, addressing the use of the package leaflet (RDC No. 95/08) (BRAZIL, 2008) and professionals who prescribe these drugs (CFO Resolution No. 82/2008; CFF No. 586/2013) (CFO, 2008; CFF, 2013).

Normative Instruction No. 4/2014 determined the publication of the Guidance Guide for Registration of Herbal Medicines and Registration and Notification of Traditional Herbal Product, the No. 2/2014 published the "List of herbal medicines for simplified registration" and the "List of traditional herbal products for simplified registration", highlighting the herbal medicine and traditional knowledge as a mechanism for prophylaxis and treatment of diseases (ANVISA, 2014; ANVISA, 2014).

Under the Single Health System – SHS, phytotherapy is a technique regulated by the National Health Policy, which in the year 2006, under the implementation of the National Policy on Medicinal and Herbal Plants of the Ministry of Health, and in 2008, with the National Program of Medicinal and Herbal Plants and its Management Committee, shows significant growth in SHS programs and the appreciation of traditional knowledge (RIBEIRO, 2019).

The beneficial effects of medicinal plants and herbal medicines are known, when used with caution, because any chemical substance in large quantities can cause harm to health (DE BARROS *et al*., 2007). In this sense, many health professionals believe in the therapeutic effect, but do not prescribe the drug, agree with the initiative of this practice integrated with traditional medicine after training in the area (MATOS *et al*., 2018).

With an increasing number of research with herbal medicine and the advancement of Brazilian legislation, health professionals do not prescribe herbal medicines because they do not know the National List of Essential Drugs (RENAME) in the Single Health System (SHS),

https://dx.doi.org/10.22161/ijaers.69.19 *ISSN: 2349-6495(P) | 2456-1908(O)*

published in 2014, which presents twelve herbal medicines (DE ANDRADE *et al*., 2017). The RENAME provides the user contact with its history, but the unavailability of the herbal medicine in the Health Units hinders the implementation of the program (MATOS *et al*., 2018).

The Policy on Medicinal Plants and Herbal Medicines in the SHS has made little progress in the face of the difficulties of access to its use in the SHS. The distorted understanding of the efficacy and safety of these drugs are frequent challenges that hinder the functioning of the program (FIGUEREDO; GURGEL; GURGEL JUNIOR, 2014). The challenges are existent to be overcome, as shown by Ibiapina*et al*., (2014), the positive aspects of the use of medicinal and herbal plants are diverse.

The insertion of herbal medicines in the SHS ensures low cost, lower incidence of side effects, high rate of acceptance among users, and approximation between scientific knowledge, and accessible expertise (IBIAPINA, 2014). The use of herbal medicine as a technique integrated with traditional, complementary and integrative medicine was the theme of the 72ndsession of the World Health Assembly of the World Health Organization – WHO, which had the participation of 7 countries (WHO, 2019).

IV. FINAL CONSIDERATIONS

It can be said that imperial Brazil brought together the indigenous knowledge, present before the colonization and that it needs to be further studied and valued, the scientific knowledge, derived mainly from the traveling naturalists who aimed to investigate the traditional expertise of colonial Brazil and the African culture that was called Afro-Brazilian culture. The combination of these three primary cultures formed a unique ethno-knowledge in the dissemination of phytotherapy present in the Brazilian floristic diversity.

In the contemporary perspective, the insertion of phytotherapy is an innovative strategy within modern western medicine to reduce the consumption of medications highly harmful to human health, recognizing the effectiveness of phytotherapy and the validation of knowledge associated with traditional communities throughout the history of humanity. The future expectations in the theme approached demonstrate to be promising since the objective of ethnopharmacology is to study the widespread knowledge about drugs.

The legalization of the production, marketing, and indications of medicinal plants as a therapeutic form in Brazil was reinforced by other legal parameters, becoming an increasingly common method in national health programs. We hope that this research can contribute to understand and strengthen the ethnobotany as a basis for studies and significant improvements to life in its diverse and varied forms, seeking respect and ties between traditional knowledge and scientific knowledge.

ACKNOWLEDGMENTS

I want to thank Fundação de Amparo à Pesquisa do Estado da Bahia – FAPESB for granting the post-graduate scholarship.

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https://dx.doi.org/10.22161/ijaers.69.20 ISSN: 2349-6495(P) | 2456-1908(O)

Physiological and Morphological Responses of Soybean Culture Submitted to Applications of Glyphosate and Glyphosate + Flumioxazine

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Abstract*—Soybean (Glycine max (L.) Merrill) is one of the most important crops in the world economy. With the official release of glyphosate- resistant transgenic soybeans in 2005, profound changes in weed management systems are occurring. The objective of the present work was to evaluate the physiological effects caused by application of EPSPS inhibitor herbicide applied in isolation and in mixture with Protox inhibitor herbicide in RR soybean plants. The experiment was conducted in the experimental area of the Federal University of Tocantins, Gurupi University Campus. The material used for planting was the cultivar SYNGENTA 1183 RR. The experimental design was a completely randomized (DIC) arranged in factorial scheme 8x6 + 1, being 8 doses of herbicides in different concentrations (4 doses of glyphosate in the dosages 480 gia ha- 1; 980 gia ha-1; 1140 gia ha- 1; 1920 gia ha-1 plus four mixing doses of the glyphosate + flumioxazin herbicides at dosages of 480 + 20, 980 + 20, 1140 + 20 and 1920 + 20 gia ha-1) and the control (no application). After the application of the herbicides, 6 physiological evaluations were carried out, the first 5 days after the application and the others of 7 in 7 DAA. The parameters evaluated were: height, diameter, phytotoxicity, photosynthesis, stomatal conductance, internal carbon and transpiration The isolated glyphosate interfered in the growth of the plants with a reduction in height in relation to the control, with increasing doses. However in the mixture there was a significant difference and in the mixture of glyphosate + flumioxazin herbicides, there was reduction in the physiological parameters.*

Keywords*—*RR soybean, herbicides, physiology.

I. INTRODUCTION

Soy (Glycine max (L.) Merrill) is one of the most important crops in the world economy. According to the USDA, the world crop of this grain will be approximately 359.49 million tons. The soybean complex, composed of soybeans in grains and their derivatives, such as soybean oil and meal, was the main product exported in 2017, accounting for 14.10% of all Brazilian exports, ie US $30.69 billion. ahead of important products such as minerals, oil, and fuels [1].

In a national senate, the main producers are Mato Grosso, Paraná, the Rio Grande do Sul and Goiás. MATOPIBA, which is composed of the states of Maranhão, Tocantins, Piauí, and Bahia, had an estimated production of 14.56 million, representing approximately 12, 3% of all national production [1].

The use of herbicides has become the most used way to control weeds in cultivated crops, however with the inadequate use of this technology, the emergence of weed species tolerant to certain herbicide molecules [2].

Currently, 480 specific cases of herbicide-resistant weed biotypes have been reported, including 251 species and 163 active ingredients, covering 91 crops distributed in 69 countries [3].

Resistance can be defined as the inherent ability of a particular weed species to survive and reproduce after exposure to a dose of lethal herbicide to the natural population. In practice, the emergence of the resistance occurs through the selection of resistant biotypes as a function of repeated and continuous application of the

https://dx.doi.org/10.22161/ijaers.69.20 *ISSN: 2349-6495(P) | 2456-1908(O)*

same herbicide or herbicides with the same mechanism of action, during a certain period of time [2].

The RR technology allowed the use of glyphosate in post-emergence of soybean, with efficient control of species resistant to ALS and ACCase inhibitors, which were the first mechanisms to which resistant weed biotypes emerged [2].

Since it was introduced in the market, the use of glyphosate has become a frequent practice, being indicated in the control of annual and perennial weeds, being non-selective the number of applications made with glyphosate usually varies according to the herbs to be treated [4].

This herbicide, because it presents a series of advantages as the broad spectrum of action is simple to apply, does not have a residual effect on the soil present high selectivity to soybean, control species and biotypes tolerant or resistant to other mechanisms of action, low cost and more (Table 1). However, the herbicide concentration is higher than that of other herbicides in the world market [5].

The intensive use of glyphosate, a herbicide inhibitor of EPSPs, has resulted in the selection of seven resistant species: ryegrass (Lolium multiflorum), buva (Conyza bonariensis, C. canadensis, C. sumatrensis), bittergrass (Digitaria insularis), caruru- palmeri (Amaranthus palmeri) and the wing-foot grass (Eleusine indica) (ADEGAS, 2017).

Therefore, the use of the same herbicide or herbicides with the same action mechanism can cause problems, such as high selection pressure, increasing the possibility of selection of resistant biotypes [6] use of mixtures of herbicides.

Research has shown that the use of glyphosate combined with herbicides of different mechanisms of action has increased the spectrum and efficacy of control of plants considered more tolerant to the action of glyphosate alone [7].

Flumioxazim, which is a PROTOX inhibitor herbicide, is effective in the control of Amaranthus viridis, Bidens pilosa, Ipomoea grandifolia and Portulaca oleracea, and Acanthosperman hispidum and Digitaria horizontalis for up to 28 days after application [8].

The use of glyphosate applied alone and in combination with other herbicides is an alternative control, including herbicide resistant plants currently used in soybean cultivation. The objective of the present work was to evaluate the physiological effects caused by application of EPSPS inhibitor herbicide applied in isolation and in mixture with Protox inhibitor herbicide in soybean plants.

II. MATERIAL AND METHODS

The experiment was conducted in the experimental area of the Federal University of Tocantins, Gurupi University Campus, located at 11 ° 43 'S, 49 ° 04' W longitude and 280 m altitude. The climate of the region is characterized as tropical climate type Aw, according to Köppen, with two well-defined seasons. The climate of the city of Gurupi according to the Thornthwaite Method Classified as C2w2A'a, hydro, evapotranspiration average annual average of 1,600 mm, distributing summer around 410 mm over the three consecutive months with higher temperature [9].

Seeding was done manually in November 2016 in plastic bags with a capacity of 5 dm3 of soil, where 4 seeds were sown per plastic bag, germination occurred 3 days after sowing, then thinning was done leaving only 1 plant per replicate . The material used for planting was the cultivar SYNGENTA 1183 RR, which is a late cycle material.

The experimental design was a completely randomized block design (DBC) of 9 treatments, (4 doses of glyphosate at dosages 480, 980 gia ha-1, 1140 gia ha-1, 1920 gia ha-1 plus four mixing doses of glyphosate herbicides + flumioxazin at dosages of 480 + 20, 980 + 20, 1140 + 20 and 1920 + 20 gia ha-1) plus the control (no application). The treatments are set forth in Table 1.

The application was carried out when the plants were in the vegetative stage V4 with the aid of a costal pulverizer pressurized to carbonic gas and equipped with nozzle type nozzles (XR 110.02) with a flow of 200 L ha-1 and constant pressure of 35 kgf / cm^2. The data collection for analysis of the development of the plants was done at intervals of 7 days, in which height (H) was collected with the aid of a ruler of 50 cm, diameter (D) with the aid of a digital caliper, and for the visual analysis of phytotoxicity caused in herbicide treatments was used in percentages, where 0% = no injury and 100% = death of the crop. After application of the herbicides, the physiological evaluations were carried out, the first 5 days after the application and the others of 7 in 7 DAA,

The physiological evaluations were performed using a portable infrared gas analyzer (IRGA, model LI-6400 XT,

LI-COR, inc. Lincoln, NE, USA). The evaluations were carried out between 9 and 11 am in order to maintain the homoge- neous environmental conditions.

The physiological parameters evaluated were net CO2 assimilation rate (A - μmol CO2 m - 2 s - 1), stomatal conductance (gs - mol H2O m - 2 s - 1), transpiration rate s-1) and internal carbon (Ci-μmol CO2 mol -1). The analyzed variables were submitted to

https://dx.doi.org/10.22161/ijaers.69.20 *ISSN: 2349-6495(P) | 2456-1908(O)*

analysis of variance using the F test and mean test with significance of 5% probability by the Scott-Knott test using the Sisvar program 5.6.

Table 1: Treatments evaluated and respective amounts of active ingredient, and commercialproduct of glyphosate and flumioxazine. (g i.a ha-1) grams of glyphosate acidequivalent in the original commercial formula Roundup @

Treatments	Commercial Product (L ha-1)	Active Ingredient (g i.a ha-1)	Stage of development
T0 - Witness	-	-	-
T1 - Glyphosate (Gly)	1,0L	480	V4
T2 - Glyphosate (Gly)	2,0L	980	V4
T3- Glyphosate (Gly)	3,0L	1140	V4
T4 - Glyphosate (Gly)	4,0L	1920	V4
T5 - Glyphosate +Flumioxazine (Gly+Flu)	1,0L	480+20	V4
T6 - Glyphosate +Flumioxazine (Gly+Flu)	2,0L	980+20	V4
T7 – Glyphosate +Flumioxazine (Gly+Flu)	3,0L	1140+20	V4
T8 - Glyphosate +Flumioxazine (Gly+Flu)	4,0L	1920+20	V4

III. RESULTS AND DISCUSSION

Table 2 shows the mean values of the height of the soybean cv. SYN 1183 RR, submitted to different doses of the herbicide glyphosate and glyphosate + flumioxazine. As shown in table 1, at 7 DAA the control differed statistically from the different concentrations of the glyphosate herbicide. Glyphosate affected the growth of soybean plants, with a reduction in height increase, relative to the control, of 13.15; 9.86; 11.74 and 10.8% at doses of (480, 980,1140 and 1920 g.i. ha-1),respectively.

At 14 DAA only the lowest dose of glyphosate (480 g.i.a ha-1) had a statistical difference in relation to the control, with a reduction in height increase of 11.69%. The gly + flu doses obtained the lowest heights, thus a statistical difference of the control, but the lowest dose of the mixture (480 + 20 gia ha-1) had the lowest reduction in height of 20.31%, differing from the other doses (980 + 20, 1140 + 20 and 1920 gia ha-1) that had reductions of 42.77; 36 and 34.15%, respectively.

At 21, 28 and 42 DAA, the control group did not present statistical difference in relation to the glyphosate doses, and at 1920 DAH, the dose 1920 gia ha-1 had a statistical similarity to the control, but the other doses of glyphosate alone differ statistically from with a reduction of 11.59% at dose 480 gia ago- 1; 17.17% at the dose 980 g.a. h-1 and 15.02% at the dose 1140 g.a. ha-1. At 28 DAA, in the glyphosate (gly + flu) treatments, only the dose 480 + 20 g.i.a ha-1 was similar with the control, while doses 980 ± 20; 1140 + 20 and 1920 + 20 g.i.a ha-1 presented statistical differences in relation to the control, corresponding to a reduction of 53.01; 45.78 and 44.06%, respectively.

At 35 DAA, a significant difference was observed in glyphosate + flumioxazine doses, but the lowest dose of gly + flu (480
+ 20 gia ha-1) was higher than the other doses, with a reduction of only 21.46% , followed by the doses 1140 + 22 and 1920 + 20 gia ha-1 which had a smaller reduction (45.49 and 40.77%, respectively) when compared to the worst dose that was 980 + 20 gia ha- 1, with a reduction in height increase of 57.08%.

At 42 DAA, the lowest dose of glyphosate (480 + 20 g.i.a ha-1) did not present a statistical difference in relation to the control, but the doses 980 + 20; 1140 + 20 and 1920 + 20 g.i.a ha-1 were statistically different, but the dose 980 g.i.a ha-1 had the worst height increase with 50.88% reduction, with doses 1140 + 20 and 1920 + 20 g.i.a ha-1 had a lower reduction in height of 21.62 and 36.94% when compared to the control. Casonatto et al; (2014) [10] verified that plant height was lower in the plants that received the highest doses of glyphosate.

According to Alonso et al., (2011) [11] working with application of the glyphosate + lactofen mixture (960 + 72 g ha-1 of ia) in the V2-V3 stage of soybean cultivar CD 214 RR, promoted a reduction of 6% and 14 % at plant height at 15 and 90 DAA, respectively, when compared to

https://dx.doi.org/10.22161/ijaers.69.20 *ISSN: 2349-6495(P) | 2456-1908(O)*

the application of glyphosate alone.

Ellis & Griffin (2003) [12] observed that treatments with glyphosate (840 and 1120 g ha-1), isolated or in mixtures, with reduced rates of chlorimuron (4.5 and 6.7 g ha-1), fomesafen (210 e 315 g ha-1) and lactofen (112 and 168 g ha-1), promoted reduction of plant height in all treatments. All stress caused to plants tends to reflect on morphophysiological changes, directly affecting their productivity [13].

Table 2: Average values of height (cm) of soybean plantscv. SYN 1183 RR, with 7, 14, 21, 28, 35 and 42 days after application (DAA) ofthe herbicide glyphosate (gly) in four(480 ± 980, 1140 and 1920 g ia ha-1), amixture of the herbicides gliphosate + flumioxazine (gly + flu) in four dosesof 480 + 20, 980 + 20, 1140 + 20 and 1920 + 20 gia ha- 1) and the control (noapplication). Gurupi - TO, 2017.

TREATMENTS	HEIGHT (cm)					
Days after application (AAD)						
	7	14	21	28	35	42
Witness	21,3 a	32,5 a	37,80 a	42,90 a	46,60 a	45,20 a
Gly (480 g.i.a. ha-1)	18,5 b	28,7 b	34,4 a	39,92 a	41,20 b	43,00 a
Gly (980 g.i.a. ha-1)	19,2 b	31,1 a	36,4 a	38,56 a	38,6 b	40,4 a
Gly (1140 g.i.a. ha-1)	18,8 b	30,8 a	35,6 a	38,62 a	39,6 b	39,8 a
Gly (1920 g.i.a. ha-1)	19,00 b	31,4 a	35,0 a	40,00 a	42,6 a	42,4 a
Gly+Flu (480+20 g.i.a. ha-1)	19,10 b	25,9 b	34,4 a	35,12 a	36,6 b	37,4 a
Gly+Flu (980+20 g.i.a. ha-1)	19,1 b	18,6 c	19,2 c	20,16 b	20,00 d	22,2 c
Gly+Flu (1140+20 g.i.a. ha-1)	19,4 b	20,8 c	24,6 b	23,26 b	25,4 c	27,00 b
Gly+Flu (1920+20 g.i.a. ha-1)	20,8 a	21,4 c	23,8 b	24,00 b	27,6 c	30,4 b
CV (%)	7,88	11,15	10,62	14,08	12,55	1,82

Means followedby the same lowercase letter in the column do not differ statistically from oneanother by the Scott-Knott test at 5% probability; (ns) is not significant; (*)significant at 5% and (**) significant at 1%.

Table 3 shows the mean values of the diameter (mm) of the cv. SYN 1183 RR, submitted to different doses of the herbicide glyphosate and glyphosate + flumioxazine.

At 7, 14 and 21 DAA it can be seen that the control presented a statistically higher diameter increase in relation to the different doses of glyphosate isolated, and the smallest increment of diameter at 7 DAA was observed at the 1140 gia ha-1 dose when compared to the control group, the lowest dose of glyphosate isolated (480 g ai ha-1) showed the smallest increase in diameter, corresponding to a decrease of 16.42%, and at 21 days of treatment of the dose 1140 gia ha-1 obtained the smallest diameter, having a reduction of 13.59% in relation to the control.

However, at 28, 35 and 42 DAA the doses of glyphosate isolated resembled the control, not differing from each other.

When analyzing the treatments of glyphosate + flumioxazin, it was observed that at 7 DAA the control did not present significant difference in relation to the doses of gly + flu. However, at 14, 21 and 28 DAA the control differed statistically from gly + flu doses (480 + 20, 980 + 20, 1140 + 20 and 1920 + 20 g ha -1)

At 35 and 42 DAA, the lowest dose of glyphosate + flumioxazine (480 + 20 gia ha-1) was statistically similar, but the other treatments of gly + flu (980 + 20, 1140 + 20 and 1920 + 20 gia ha-1), in the two evaluation periods (35 and 42 DAA), were statically different when compared to the control, having a reduction of 27.66; 24.03 and 26.14% in the 35 DAA and 29.12; 29.88 and 28.56% at 42 DAA.

https://dx.doi.org/10.22161/ijaers.69.20 *ISSN: 2349-6495(P) | 2456-1908(O)*

Table 3: Valoresmédios de diâmetro (mm) de plantas de soja cv. SYN 1183 RR, com 7, 14, 21, 28,35 e 42 dias após aplicação (DAA) do herbicida glyphosate (gly) em quatro doses(480, 980, 1140 e 1920 g.i.a ha^{-1}), mistura dos herbicidasgliphosate + flumioxazina (gly+flu) em quatro doses de (480+20, 980+20, 1140+20e 1920+20 g.i.a ha^{-1}) e a testemunha (sem aplicação). Gurupi - TO,2017.

Witness	DIAMETER (mm)					
Days after application (AAD)						
	7	14	21	28	35	42
Testemunha	4,16 a	6,82 a	7,21 a	8,66 a	8,85 a	10,71 a
Gly (480 g.i.a. ha-1)	3,56 b	5,7 b	6,32 b	7,9 a	8,66 a	10,27 a
Gly (980 g.i.a. ha-1)	3,49 b	5,74 b	6,47 b	7,97 a	8,53 a	10,62 a
Gly (1140 g.i.a. ha-1)	3,12 b	6,00 b	6,23 b	8,35 a	8,32 a	10,5 a
Gly (1920 g.i.a. ha-1)	3,58 b	5,82 b	6,26 b	7,58 a	8,5 a	9,77 a
Gly+Flu (480+20 g.i.a. ha-1)	3,88 a	5,28 c	5,35 c	7,00 b	8,11 a	9,25a
Gly+Flu (980+20 g.i.a. ha-1)	4,3 a	4,98 c	5,16 c	5,93 b	6,17 b	7,52 b
Gly+Flu (1140+20 g.i.a. ha-1)	3,94 a	5,38 c	5,11 c	6,00 b	6,48 b	7,44 b
Gly+Flu (1920+20 g.i.a. ha-1)	4,06 a	4,84 c	4,91 c	5,6 b	6,3 b	7,58 b
CV (%)	12,86	11,09	10,51	13,90	10,55	10,65

Means followedby the same lowercase letter in the column do not differ statistically from oneanother by the Scott-Knott test at 5% probability; (ns) is not significant; (*)significant at 5% and (**) significant at 1%.

Table 4 shows the mean values of phytotoxicity (%) of soybean cv. SYN 1183 RR, submitted to different doses of the herbicide glyphosate and glyphosate + flumioxazine.

At 7, 14, 21, 28, 35 and 42 DAA, a visual evaluation of the toxicity of soybean plants as a function of time was carried out at doses of glyphosate isolated (480, 980, 1140 and 1920 gia ha-1), showing no effects of the glyphosate herbicide isolated. Even at the highest dose (1920 g.i.a ha-1) the visual intoxication was not noticed when compared to the control (without application), showing that the increase of the concentration of the herbicide did not affect soybean plants.

When analyzing treatments with glyphosate + flumioxazine doses (480 + 20, 980 + 20, 1140 + 20 and 1920 + 20 gia ha- 1), when compared to the control, soybean cultivar obtained 100% of visual intoxication, thus presenting significant difference in relation to the control. When the comparison between the gly doses and the gly + flu doses, it was verified that there was a significant difference, with the doses of gly isolated were superior 100% in relation to the doses of gly + flu in the visual intoxication of the plants of soy.

When compared between the different doses of gly + flu, the lowest dose (480 + 20 gia ha-1) had the lowest effect of intoxication in relation to the other doses (980 + 20, 1140 + 20 and 1920 + 20 gia ha-1) in all the evaluation periods (7,14,21,28,35 and 42 DAA).

Procópio et al. (2007) [7]working with isolated application of glyphosate at the doses of 480, 960 and 1440 g ha-1 in RR® soybean plants did not verify symptoms of intoxication irrespective of the test dose isolated from glyphosate. These data do not corroborate those found by [14] Foloni et al. (20b05), who observed mild intoxication effects in RR® soybean plants (Monsoy 8888) after isolated applications of Glyphosate.

According to Alonso et al. (2011) [15] the glyphosate + lactophene mixture caused severe visible lesions, showing symptoms similar to those observed in treatment with glyphosate + fomesafen, although with greater intensity.

https://dx.doi.org/10.22161/ijaers.69.20 *ISSN: 2349-6495(P) | 2456-1908(O)*

Table 4: Average values of phytotoxicity (%) of soybeanplants cv. SYN 1183 RR, with glyphosate (gly) herbicide at four doses (480,980, 1140 and 1920 gia ha-1) at 7, 14, 21, 28, 35 and 42 days after application(DAA) flumioxazine (gly + flu) in four doses of (480 + 20, 980 + 20, 1140 + 20and 1920 + 20 gia ha-1) and the control (no application). Gurupi - TO, 2017.

TREATMENTS	PHYTOXITY (%)					
Days after application (AAD)						
	7	14	21	28	35	42
Witness	0,00 a	0,00 a	0,00 a	0,00 a	0,00 a	0,00 a
Gly (480 g.i.a. ha-1)	0,00 a	0,00 a	0,00 a	0,00 a	0,00 a	0,00 a
Gly (980 g.i.a. ha-1)	0,00 a	0,00 a	0,00 a	0,00 a	0,00 a	0,00 a
Gly (1140 g.i.a. ha-1)	0,00 a	0,00 a	0,00 a	0,00 a	0,00 a	0,00 a
Gly (1920 g.i.a. ha-1)	0,00 a	0,00 a	0,00 a	0,00 a	0,00 a	0,00 a
Gly+Flu (480+20 g.i.a. ha-1)	73,00 b	73,00 b	55,00 b	49,80 b	42,00 b	39,00 b
Gly+Flu (980+20 g.i.a. ha-1)	87,00 c	87,00 c	84,00 d	78,20 d	74,00 d	73,00 d
Gly+Flu (1140+20 g.i.a. ha-1)	84,00 c	84,00 c	73,00 c	65,40 c	66,00 c	60,00 c
Gly+Flu (1920+20 g.i.a. ha-1)	87,00 c	87,00 c	83,00 d	74,40 d	67,00 c	69,00 d
CV (%)	6,57*	6,57*	14,03*	13,77*	18,23*	14,19*

Means followedby the same lowercase letter in the column do not differ statistically from oneanother by the Scott-Knott test at 5% probability; (ns) is not significant; (*)significant at 5% and (**) significant at 1%.

Table 5 shows the average values of photosynthesis (μmol CO2 m-2 s-1) of cv. SYN 1183 RR, submitted to different doses of the herbicide glyphosate and glyphosate + flumioxazine.

At 7, 21, 28, 35, 42 DAA, the control compared to the glyphosate (gly) treatments alone did not show statistical difference by the Scott-Knott test at 5% probability, however the 14 DAA the control was shown statistically lower than the treatments for gly alone.

At 7 DAA, the control presented a statistical difference by the Scott-Knott test at a 5% probability, when compared to the glyphosate + flumioxazine (gly + flu) treatments, and the control was higher at 39, 47% at the 480 gia ha- 1, 43.03% the dose 980 gia ha-1; 45.61% the dose 1140 g.a. ha-1e 52.16% a dose 1920 g.i.a. ha-1. The gly glycerol levels were higher than the gly
+ flu doses, and the gly-flu doses were higher than the gly + flu doses, with the Scott-Knott test at 5% probability, flu.

At 14 DAA when comparing the control with the doses of gly + flu, it was verified that there was statistical difference by the Scott-Knott test at 5%, and the control was lower than 480 + 20 gia ha-1 and 1140 + 20 doses gia ha-1 with a reduction of 34, 53% and 42.91%, respectively. However, when gly doses were compared with gly + flu doses, the doses of gly 980 gia ha-1e and 1920 gia ha-1 were higher 26.56% and 40.29%, respectively with respect to gly dose + flu of 480 + 20 gia ha-1e 1920 + 20
g.i.a ha-1, with the other doses of gly and gly + flu being statistically similar.

At 28, 35 and 42 DAA, the control did not present statistical difference with the gly + flu doses, and it was the same when comparing gly doses isolated with gly + flu doses.

At 28, 35 and 42 DAA, no differences were observed between the different doses of glyphosate + flu in relation to the control, where there was also no difference when compared to the doses of gly and gly + flu.

Zobiole et al. (2010) [16] observed that the single application (1,200 g.i.a ha -1) had a greater negative effect on photosyn- thesis. Similar results were observed by [16] Zobiole et al. (2010b) during the evaluation of different doses of glyphosate (600 a 2,400 g.i.a ha-1) in unique applications.

Table 6 shows the mean values of the stomatal conductance (gs, mol H2O m-2 s-1) of the cv. SYN 1183 RR, submitted to Different doses of the herbicide glyphosate and glyphosate + flumioxazine

https://dx.doi.org/10.22161/ijaers.69.20 *ISSN: 2349-6495(P) | 2456-1908(O)*

Table 5: Mean values of photosynthesis (µmol CO2 m-2 s-1) of soybean plants cv. SYN 1183 RR, withglyphosate (gly) herbicide at four doses (480, 980, 1140 and 1920 gia ha-1) at7, 14, 21, 28, 35 and 42 days after application (DAA) flumioxazine (gly + flu)in four doses of (480 + 20, 980 + 20, 1140 + 20 and 1920 + 20 gia ha-1) and thecontrol (no application). Gurupi - TO, 2017.

TREATMENTS	A (µmol CO2 m-2 s-1) Days after application (AAD)					
	7	14	21	28	35	42
Witness	12,06 a	10,02 b	15,57 a	15,97 a	20,56 a	22,9 a
Gly (480 g.i.a. ha-1)	11,85 a	13,39 a	17,25 a	16,35 a	20,47 a	21,61 a
Gly (980 g.i.a. ha-1)	11,89 a	13,48 a	17,06 a	15,06 a	19,53 a	18,48 a
Gly (1140 g.i.a. ha-1)	11,91 a	14,32 a	15,49 a	13,57 a	20,56 a	22,88 a
Gly (1920 g.i.a. ha-1)	10,96 a	14,32 a	14,93 a	15,48 a	20,33 a	23,57 a
Gly+Flu (480+20 g.i.a. ha-1	7,3 b	12,32 a	15,11 a	15,09 a	20,08 a	19,88 a
Gly+Flu (980+20 g.i.a. ha-1)	6,87 b	9,9 b	4,95 b	14,44 a	19,2 a	21,53 a
Gly+Flu (1140+20 g.i.a. ha 1)	6,56 b	11,95 a	16,94 a	14,43 a	18,81 a	20,82 a
Gly+Flu (1920+20 g.i.a. ha-1)	5,77 b	8,55 b	14,89 a	15,3 a	18,26 a	20,07 a
CV (%)	10,60*	12,14*	16,59*	20,74ns	10,94ns	14,88ns

Means followedby the same lowercase letter in the column do not differ statistically from oneanother by the Scott-Knott test at 5% probability; (ns) is not significant; (*)significant at 5% and (**) significant at 1%.

At 7, 14, 28, 35 and 42 the control did not differ statistically from the doses of gly isolated. However at 21 DAA the gly doses of 480, 980 and 1920 g.i.a ha-1 were statistically higher than the control with an increase in GS of 61.9%, 37.09%, and 24.19%.

When comparing the gly + flu treatments to the 7 DAA with the control, it was verified that there was statistical difference by the scott test, where the control had an increase in the photosynthetic rate of 59.05; 66.67; 72,22 and 100% corresponding to the doses of 480 980 1140 1920. When comparing the doses of gly with the doses of gly + flu, it is verified that there was significant difference, being the doses of gly superior the doses of gly + flu in the conductance.

At 14, 28, 35 and 42 DAA, the control did not present statistical difference in relation to the gly + flu doses, being the same in gly treatments isolated compared to gly + flu.

And at 21 DAA only the treatments of gly + flu at doses 980 + 20 and 1140 + 20 g.i.a ha-

1 deferred from the control, the dose 980 + 20 reduced 47.1 and dose 1140 increased 39.52% over the control. When the different doses of gly and gly + flu were related, at doses of gly 480, 980 and 1920 g.i.a ha-1 were higher 35.4; Respectively, when compared to gly + flu doses 480 + 20, 980 + 20 and 1920 + 20 gia ha-1, and the dose of gly 1140 g ha -1 is lower than 22.65% in relation to the 1140 + 20 gia ha-1 dose of gly + flu.

According to Magalhães Filho et al. (2008) [17], the partial stomatal closure leads to a decrease in the stomatal conductance (gs) and consequently the increase in the substomatic CO2 (Ci).

Table 7 shows the average values of internal CO2 concentration (µmol CO2 mol-1) of cv. SYN 1183 RR, submitted to different doses of the herbicide glyphosate and glyphosate + flumioxazine.

https://dx.doi.org/10.22161/ijaers.69.20 *ISSN: 2349-6495(P) | 2456-1908(O)*

Table 6: Mean values of stomatal conductance (mol H2O m-2s-1) of cv. SYN 1183 RR, with glyphosate (gly) herbicide at four doses (480,980, 1140 and 1920 gia ha-1) at 7, 14, 21, 28, 35 and 42 days after application(DAA) flumioxazine (gly + flu) in four doses of (480 + 20, 980 + 20, 1140 + 20and 1920 + 20 gia

ha-1) and the control (no application). Gurupi - TO, 2017.

TRATAMENTOS	Gs (mol H2O m-2 s-1)					
Days after application (AAD)						
	7	14	21	28	35	42
Witness	0,144 a	0,087 a	0,62 b	0,863 a	0,590 a	0,793 a
Gly (480 g.i.a. ha-1)	0,136 a	0,161 a	1,00 a	1,116 a	0,665 a	0,859 a
Gly (980 g.i.a. ha-1)	0,146 a	0,156 a	0,85 a	0,978 a	0,656 a	0,764 a
Gly (1140 g.i.a. ha-1)	0,145 a	0,154 a	0,669 b	0,957 a	0,67 a	0,904 a
Gly (1920 g.i.a. ha-1)	0,131 a	0,147 a	0,771 a	0,839 a	0,652 a	0,945 a
Gly+Flu (480+20 g.i.a. ha-1)	0,059 b	0,118 a	0,646 b	1,121 a	0,619 a	0,743 a
Gly+Flu (980+20 g.i.a. ha-1)	0,048 b	0,085 a	0,328 c	1,276 a	0,608 a	0,793 a
Gly+Flu (1140+20 g.i.a. ha-1	0,040 b	0,130 a	0,865 a	0,924 a	0,567 a	0,732 a
Gly+Flu (1920+20 g.i.a. ha-1)	0,000c	0,097 a	0,695 b	0,970 a	0,529 a	0,686 a
CV (%)	27,268	34,71ns	30,32*	33,16ns	19,53ns	27,57 ns

Means followedby the same lowercase letter in the column do not differ statistically from oneanother by the Scott-Knott test at 5% probability; (ns) is not significant; (*)significant at 5% and (**) significant at 1%.

At 7, 14, 21 and 28 DAA the gly doses did not present statistical difference in relation to the control, and at 35 and 42 DAA the control statistically resembled the doses of gly isolated.

At 7, 14, and 28 DAA, glyphosate + flumioxazine treatments did not differ statistically from the control, but at 21 DAA, when comparing the control with Gly + Flu doses (480 + 20; 980 + 20; 20 + 20 gia ha-1) only the 980 + 20 gia ha-1 treatment presented a statistical difference when compared to the control, with a 17.02% increase in the internal CO2 concentration.

At 35 DAA the control statistically differentiated from the gly + flu doses by the Scott-Knott test, with a reduction of the gly + flu doses, it can be seen that there was statistical difference with respect to the control, that is, all (480 + 20 gia ha-1) of 4.89%, while the other doses (980 + 20, 1140 + 20 and 1920 + 20 gia ha-1) corresponded to a decrease of 7.32; 9.71 and 11.62% in the CO2 Ci, respectively, relative to the control.

At 7, 14 and 28 DAA when comparing the doses of gly with the doses of gly + flu, it verified that there was no statistical difference, being that at 21 DAA only the dose 980 + 20 gia ha-1 of gly + flu presented statistical difference , when gly doses were compared with gly + flu doses, with an increase of 13.67% over the 980 gia ha-1 gly dose alone.

At 35 DAA the gly doses of 480, 980 and 1140 g.i.a ha-1 presented statistical differences when compared to gly + flu doses of 480 + 20, 980 + 20; 1140 + 20 g.i.a. ha-1, the gly doses being lower than the blend, with a reduction of 6.8; 3.6 and 2.77%. At 42 DAA only 480 + 20 g.i.a ha-1 differed statistically when compared to gly doses with gly + flu, being 3.67% higher than gly dose of 480 g.i.a ha-1.

https://dx.doi.org/10.22161/ijaers.69.20 *ISSN: 2349-6495(P) | 2456-1908(O)*

Table 7: Mean values of internal CO2 concentration (µmolCO2 mol-1) of soybean plants cv. SYN 1183 RR, with glyphosate (gly) herbicideat four doses (480, 980, 1140 and 1920 gia ha-1) at 7, 14, 21, 28, 35 and 42days after application (DAA) flumioxazine (gly + flu) in four doses of (480 +20, 980 + 20, 1140 + 20 and 1920 + 20 gia ha-1) and the control (noapplication). Gurupi - TO, 2017.

TREATMENTS	Ci (µmol CO2 mol-1)					
Days after application (AAD)						
	7	14	21	28	35	42
Witness	207,31 a	128,91 a	211,03 b	230,85 a	257,49 a	279,45 a
Gly (480 g.i.a. ha-1)	176,26 a	199,64 a	218,37 b	224,82 a	228,25 d	271,83 b
Gly (980 g.i.a. ha-1)	188,25 a	192,36 a	213,20 b	225,52 a	230,05 d	268,69 b
Gly (1140 g.i.a. ha-1)	185,22 a	183,22 a	207,90 b	222,07 a	226,03 d	268,35 b
Gly (1920 g.i.a. ha-1)	182,12 a	171,8 a	218,33 b	218,90 a	223,75 d	264,71 b
Gly+Flu (480+20 g.i.a. ha-1)	166,58 a	176,75 a	214,8 b	233,16 a	244,9 b	282,20 a
Gly+Flu (980+20 g.i.a. ha-1)	154,55 a	149,71 a	246,94 a	237,3 a	238,65 c	273,23 b
Gly+Flu (1140+20 g.i.a. ha-1	193,84 a	182,81 a	215,69 b	226,38 a	232,48 c	272,42 b
Gly+Flu (1920+20 g.i.a. ha-1)	198,52 a	139,12 a	215,64 b	224,00 a	227,58 d	269,79 b
CV (%)	30,23ns	36,61ns	4,72*	4,19ns	2,31*	2,16*

Means followedby the same lowercase letter in the column do not differ statistically from oneanother by the Scott-Knott test at 5% probability; (ns) is not significant; (*)significant at 5% and (**) significant at 1%.

The transpiration (E, mol H2O m-2 s-1) in soybean plants as a function of the application of doses of glyphosate isolated and with the mixture (glyphosate + flumioxazine) at different times after application are described in table 8.

At 7, 21, 28, 35 and 42 DAA treatments with doses of glyphosate alone did not differ statistically from the control by the 5% probability scott-Knott test. However at 14 DAA glyphosate doses presented a statistical difference in relation to the control, where the doses of gly isolated had an increase 54,34; 47.4; 46.24 and 42.2% in the transpiratory rate at doses 480, 980, 1140 and 1920 g.i.a ha-1 when compared to the control.

When observing gly + flu treatments at 7 DAA, it was verified that the control was superior, thus presenting a significant difference between them, however, the doses 480 + 20, 980 + 20 and 1140 + 20 gia ha-1 excelled in relation at dose 1920 + 20 g.i.a ha-1. The reduction was 47.98; 51,45 and 62,43% in doses 480 + 20, 980 + 20 and 1140 + 20 gia ha-1, respectively, while the highest dose (1920 + 20 gia ha-1) obtained the lowest E corresponding to a decrease of 99.42% in relation to the control.

At 14 DAA the dose 1140 + 20 g ha -1 had a significant difference with respect to the control, having an increase of 35.84%.

The other treatments presented statistical similarity to the control by the Scott-Knott test at 5% probability.

At 21 DAA only the treatment of glyphosate + flumioazim (980 + 20 g.i.a ha-1) presented a statistical difference in relation to the control, with a reduction of 33.90%, and those with more treatments obtained statistical similarity.

At 28, 35 and 42 DAA, all gly + flu treatments did not differ statistically when compared to the control.

At 7 DAA when comparing the doses of gly with the doses of gly + flu, it was verified that there was statistical difference between them, however the doses of gly isolated (480, 980, 1140 and 1920 gia ha-1) corresponding to an increase of 48.28; 53.59; 63.68 and 93.94% relative to the gly + flu doses of 480 + 20, 980 + 20, 1140 + 20 and 1920 + 20 g.i.a ha-1, respectively.

At 14 DAA the gly + flu doses 480 + 20, 980 + 20 and 1920 + 20 gia ha-1 were lower than the doses 480, 980 and 1920 of gly, with statistical difference between them, whereas the doses of gly increased 24.72; 33.73 and 24.8% in relation to gly + flu doses (480 + 20, 980 + 20 and 1920 + 20 gia ha-1), and at 21 DAA only the treatment of 980 gia ha-1 of gly was statistically different from dose 980 + 20 g.i.a ha-1, the upper dose being 40.97% in the transpiratory rate. At 28, 35 and 42 DAA the gly doses were not statistically different in relation to gly doses+ flu.

https://dx.doi.org/10.22161/ijaers.69.20 *ISSN: 2349-6495(P) | 2456-1908(O)*

Table 8: Mean values of transpiration (mol H2O m-2 s-1)of soybean plants cv. SYN 1183 RR, with glyphosate (gly) herbicide at fourdoses (480, 980, 1140 and 1920 gia ha-1) at 7, 14, 21, 28, 35 and 42 days afterapplication (DAA) flumioxazine (gly + flu) in four doses of (480 + 20, 980 +20, 1140 + 20 and 1920 + 20 gia ha-1) and the control (no application). Gurupi- TO, 2017.

TREATMENTS	E (mol H2O m-2 s-1)					
	Days after application (AAD)					
	7	14	21	28	35	42
Witness	1,90 a	1,73 b	6,43 a	9,44 a	5,21 a	6,27 a
Gly (480 g.i.a. ha-1)	1,74 a	2,67 a	7,64 a	8,85 a	5,57 a	6,90 a
Gly (980 g.i.a. ha-1)	1,81 a	2,55 a	7,20 a	8,66 a	5,42 a	6,36 a
Gly (1140 g.i.a. ha-1)	1,79 a	2,53 a	6,69 a	8,07 a	5,40 a	7,06 a
Gly (1920 g.i.a. ha-1)	1,65 a	2,46 a	7,03 a	8,17 a	5,28 a	6,65 a
Gly+Flu (480+20 g.i.a. ha-1)	0,90 b	2,01 b	6,55 a	8,80 a	5,28 a	6,26 a
Gly+Flu (980+20 g.i.a. ha-1)	0,84 b	1,69 b	4,25 b	8,60 a	5,36 a	6,78 a
Gly+Flu (1140+20 g.i.a. ha-1)	0,65 b	2,35 a	7,24 a	8,22 a	5,18 a	6,73 a
Gly+Flu (1920+20 g.i.a. ha-1)	0,01 c	1,85 b	6,82 a	8,53 a	4,94 a	6,54 a
CV (%)	26,18*	22,03*	14,61*	13,11ns	6,77ns	10,5ns

Means followedby the same lowercase letter in the column do not differ statistically from oneanother by the Scott- Knott test at 5% probability; (ns) is not significant; (*)significant at 5% and (**) significant at 1%.

IV. CONCLUSIONS

Glyphosate did not significantly interfere in plant growth with a gradual reduction in height increase relative to the control, with increasing glyphosate doses both isolated and mixed.

When the phytotoxicity was evaluated, the visual intoxication was not observed, when compared to the control (without ap- plication), showing that the increase of the concentration of the herbicide did not affect soybean plants. However, the glyphosate + flumioxazine doses showed that the soybean cultivar obtained 100% intoxication, as they presented physiological damage in the soybean leaves compared to the control.

Over time in photosynthesis, stomatal conductance, transpiration and internal carbon, when compared with the control, there was no reduction of the same in the treatment with glyphosate alone.

It was observed that there is still a need for research evaluating the physiological suitability of specific soybean cultivars to determine the tolerance of the crop to different mechanisms of action in order to minimize the frequent use of herbicides and weed control strategies. good performance and productivity of the crop.

ACKNOWLEDGEMENTS

Universidade Federal Do Tocantins

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https://dx.doi.org/10.22161/ijaers.69.21 ISSN: 2349-6495(P) | 2456-1908(O)

Governance Practices, Commercial and Social Relations in Brazilian Soccer Clubs

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Abstract *— It may be assumed that Brazilian soccer clubs should broaden their horizons in terms of their economic and social maintenance through more effective commercial activities. This can be done through greater transparency of their strategic activities in terms of their relationships with partners such as investors, supporters, governments and the public. This study focuses on the following research question: how can the adoption of governance practices by the main soccer clubs in Brazil create new business relationships? The study analyzes the adoption of governance practices and the relationship with partners in 14 soccer clubs with the highest revenues in the country. The method was a multiple case study with a qualitative and quantitative analysis approach. The data were compiled in 5 dimensions with 48 indicators of the Brazilian Governance Institute. The description resulted in a suggestion for adapting the structure and practice of governance of soccer clubs through transparency, advice, norms and social actions as a framework for economic and social sustainability through better business relationships with direct and indirect partners.*

Keywords *— **sport governance, corporate club, business relation.***

I. INTRODUCTION

Understanding the current governance and management profile imposed to the clubs over the last decade raises the question of why some entities adopt strategies that lead to expected economic and social outcomes, while other entities do not. The importance of governance [1],[2] on the outcomes of the organizations is already broadly known. However, there is little empirical evidence of how the adoption of governance practices impacts relationships with various partners, which for this study is between the Brazilian soccer clubs and their business partners.

Different from other economic sectors, the origin of soccer was a combination of single international, national, regional and professional entities; and it is responsible for a great portion of the economic activity on the sports and entertainment market, not only by employing coaches, athletes and officers, but also by engaging different people directly and indirectly related to the show.

According to Somoggi (2017), the balance sheet (2015/2016) of the 20 clubs with the largest revenues in Brazil had an increase of 30.2% when compared to 2015, which means nearly R$ 4.9 billion (91% of the total domestic revenue), and the Brazilian market of soccer clubs reached R$ 5.4 billion in 2015, emphasizing the broad representativeness of such 20 clubs in comparison to the all the 776 registered professional clubs [3],[4].

Even when considering such scenario of business opportunity, effective actions or changes are not observed in the management behaviour or the organizational structure of the federation, confederations or soccer clubs, which would justify the revision of the instruments that enable them to achieve financial health [5].

Despite the time gap of the analyzed period (2007/2017), current data show the repetition of the same mistakes throughout the reference period. According to Somoggi (2017), those 20 clubs with the largest revenues in Brazil present a 'hyper-dependence' on television revenues, representing 51% of the total revenues assessed in the period of 2015/2016; the remaining revenue is complemented by sponsorship, advertisement, partnerships, ticket sales and trade of athletes [3].

The lack of professional qualification on sports and governance has allowed for controversial actions by entities and clubs, which resulted in the Parliamentary Commission of Investigation in the Brazilian Congress. Such fact compromised the clubs' images, as the discussion raised concerns on the management of sports institutions, which should have had transparency as reference for their relationship with the government.

https://dx.doi.org/10.22161/ijaers.69.21 *ISSN: 2349-6495(P) | 2456-1908(O)*

Conmebol (South American Football Confederation), by means of the Circular Proceeding 06/2015, of 07/29/2015, introduced the 'Compliance Program', elaborated to ensure greater efficiency and transparency to the activities of the confederation and, consequently, its affiliates, requiring management transparency and governance in order to improve its processes and operations' integrity, since they demand that clubs involved in championships organized by Conmebol have in place management models that comply with legal and administrative requirements.

The purpose of this research may be outlined as 'to describe the model to adopt governance practices and their possible effects on new business relations' for the 14 clubs with greatest national projection (CBF Ranking/2017) and revenue ([6],[3]), as shown on Table 1 (revenues in descending order).

Table 1: Revenue without athlete transfer - 14 Clubs

RK 2016	CLUBS	STATE	Revenue 2015 (in millions of reais)	Revenue 2016 (in millions of reais)
1	Palmeiras	SP	344	469
2	Flamengo	RJ	323	382
3	São Paulo	SP	265	346
4	Corinthians	SP	281	309
5	Grêmio	RS	185	225
6	Atlético MG	MG	231	300
7	Cruzeiro	MG	269	218
8	Internacional	RS	224	206
9	Fluminense	RJ	164	176
10	Santos	SP	168	245
11	Vasco da Gama	RJ	183	205
12	Botafogo RJ	RJ	115	153
13	Atlético	PR	129	147
14	Coritiba	PR	81	102

Note. Source: Itau BBA. Financial and Economical Analysis of the Brazilian Soccer Clubs https://www.dropbox.com/s/s4p8ne63lc53w0jt/Analise%20Preliminar%20de%202016%20Itau%20BBA.pdf?dl=0= Entry in 07.06.2017. This projection takes some assumptions into account: non-receipt of gloves, athletes sales movements (data spread by spoken and written press)

Specifically, we seek answers to the following questions: What are the main governance characteristics of the researched soccer clubs regarding transparency, committees, audits, standards, councils, and social and environmental actions? What is the interference of the internal stakeholders: Decision-Making Council, Board of Directors, Advisory Board, Fiscal Committee, as well as Executive Management? What is the interference of external stakeholders: Brazilian Federal Government, Brazilian Soccer Confederation, State Federations, media and sponsors? What governance practices are recommended in order to expand the commercial perspectives of the researched clubs?

Below, the theoretical grounds that support the data analysis for this research are presented. After that, there is a report about the methodology and procedures and the data analysis itself. Finally, the final considerations and proposals for future studies are presented.

1.1 Soccer clubs management models in Brazil

According to Leoncini and Silva (2001), the management of soccer clubs in Brazil is influenced by internal and external forces, which influence their management models [7]. External forces such as effective legislation and industry practices affect the clubs, such as the Pelé Law, which causes significant changes to the management method.

As for internal forces, influences refer to economic and sports outcomes, the admission of new agents, poor performance in the field, athletes being sold, the pass-on law, the stadiums' awful conditions, among many other factors.

As there have not been major changes to such practices, this background shows signs of the internal management conditions of the Brazilian soccer clubs. In this regard, Aidar, Leoncini, and de Oliveira (2002) suggest that there are different management models in Brazilian soccer, and that each of them meets certain characteristics and interests of the involved parties [8]. That model is then chosen to meet short-term financial goals, rather than more detailed mid and long-term analyses, such as those listed below:

a) Co-management – Its main characteristic is to establish rights and duties for both parties, e.g. the club and its sponsor;

b) Trademark Licensing and Soccer Department Outsourcing – When the social club grants the investor with rights to use the trademark;

c) Acquisition – When the club and the investor create a new company, which becomes the holding company and the owner of the soccer team;

d) Creation – When the investor creates the soccer team already as a company, in which all assets belong to the club-company and its revenue results from the club's business.

In the authors' opinion, this is a pre-established set of principles and duties of an organization, which directs its funds in favor of achieving its purposes, without ever clarifying the formalization of the governance practices that would establish a transparent relationship between the club and its partners.

1.2 Governance

Governance, for the purposes of this study, is the basis that guides the managerial model and business model rules. In this sense, the Brazilian Institute of Corporate Governance (BICG) considers governance as a system through which organizations are managed and monitored, involving the shareholders and quota holders, as well as the Board of Directors (BOD), the Board of Executive Officers, Independent Audit Companies and the Fiscal Committee. The purpose of governance is to increase the company's value, facilitate access to capital, as well as contribute to its perpetuity. According to the Institute

https://dx.doi.org/10.22161/ijaers.69.21 ISSN: 2349-6495(P) | 2456-1908(O)

(Brazilian Governance Institute) the principles and practices of a good Corporate Governance apply to organizations of any nature (any size or type of control) [9].

The concept of governance allows one to view the structuration of organizational processes that govern the relationships between shareholders, managers and other partners [10]. In a recent period, discussions on corporate governance started including not only the managers' control for the organizational unit, but also the relationship with all stakeholders. Thus, good governance shall drive the organization towards achieving effectiveness, considering the interests of the parties that are involved and affected by managerial actions. According to Rese (2012), the organizations' multi-faced nature and their relationships cause conflicts of interest, management and governability, leading the organization to the preeminence of creating a governance mechanism that outlines and establishes the roles of each agent in this setting, ensuring that the different interests of the involved parties are met [11].

In this regard, the best corporate governance practices recommended by the Organization for Economic Cooperation and Development may be summarized in the following items [12]:

a) Transparency in meetings (accountability), ownership structures (established and legitimized), control groups (identified and acknowledged) and equity interest (regardless of the number);

b) Clearly established structure and liability for the Board of Directors (not only meeting the interest of an emerging political group);

c) Protection of minority equity holders;

d) Audits, legal compliance, statements of evaluation indicators and transparency in relationships (periodic control actions).

It is noteworthy that in the case of Brazilian soccer clubs, the boards comprise various elements (businesspeople, politicians, independent professionals, etc.), representing the various political forces of the club, which emerge according to the performance in the field achieved during the current management. Summarizing, such fluctuation hinders investment raising, for it drives the shareholder (and/or stakeholder) away from the soccer's business dynamics due to legal and corporate characteristics in force in Brazil, which prevent non-profit institutions to have a more active participation in the management of the clubs.

On the other hand, clubs in Europe are often incorporated as a company, since ownership structures are more favorable to proposals of governance.

In Brazil, soccer clubs are incorporated as non-profit entities, and their management is assigned to partners elected as executive officers, and there is no direct connection with having the necessary competence to exercise the position. Thus, it is noteworthy to mention the position of Hoye, Nicholson, and Houlihan (2010) on the aspects that must be considered regarding third-party activity regulation [13]. The authors mention that the lack of control and transparency in the documentation of decision-making processes, as well as the inability to punish managers, are some of the observed deficiencies and they are directly related to sports organizations. In this regard, Chelladurai and Madella (2006) state the need for a bureaucratic essence to sports organizations, since there must be a well-established work division, as well as clear authority lines, in addition to formalized procedures and rules [14]. Managers' autonomy, as pointed out by Viana and Fontes (2011), can establish better governance and management practices for clubs, since it requires an improved relationship with stakeholders, especially for consolidating implemented strategies and actions [2]. However, clubs would be required to present proper structures to the financing agents, seeking transparency in fund allocation and in their actions.

Ferkins and Shilbury (2010) use defined professional management and bureaucratic processes as starting point, resulting in the following topics: shared leadership (with an interesting discussion on the effective participation of all stakeholders involved in the club's management, since the participation in professional management is deemed as certain, thus reducing the passionate connection of managers in routine decisions of sports organizations) [15]; motivation (internal and personal aspects), rules (regulatory standards) and structure of the Board (encouraging and strengthening the participation of professional managers, especially voluntary managers who observe the lack of recognition and time, issues that interfere with the quality of interventions by the Board).

Next, based on the proposed objectives, there is a description of the methodology used in this investigation, as well as the procedures for data analysis and collection.

II. METHODOLOGY

The research may be characterized as a mixed-method research [16]. In order to meet the research's characteristics, a sequential exploratory strategy was chosen, involving a first stage of collection and analysis of qualitative data (structured questionnaire), followed by a second stage of collection and analysis of quantitative data (statistical analysis), developed based on the first-stage results [17].

https://dx.doi.org/10.22161/ijaers.69.21 ISSN: 2349-6495(P) | 2456-1908(O)

Based on the theoretical definitions and the use of a structured questionnaire (Appendix 1) for the 14 clubs with the largest revenue in Brazil (Table 1), a study of multiple cases has started, and it enabled a better definition of the profile of practices involved in the constructs of this work. The information was researched along with provided documents and reports that are available to the public at the clubs' official websites. The instrument of collection was a questionnaire structured with 5 Dimensions and 48 reflection points, as per the IBG's indicators (Brazilian Governance Institute), disposed as follows: Transparency (D1/16 indicators); Boards and Audit (D2/18 indicators); Regulatory Standards (D3/4 indicators); Meeting (D4/3 indicators) and Return on social investment/SRIU (D5/7 indicators).

III. DATA ANALYSIS

The following statistical analyses have been performed: calculation of Spearman's correlation coefficient (r_{ij}), in which i and j represent the dimensions; Bartlett's test for sphericity hypothesis; principal component analysis; factor analysis and cluster analysis. The factor analysis was performed through a correlation matrix. The clubs' cluster analysis used the centroid method and, as dissimilarity measure, the Euclidean distance. As for statistical analyses, they were performed in the R software [18].

IV. RESULTS AND DISCUSSION

Through the calculation of the Spearman's correlation coefficient between dimensions, it was noted that the following dimension pairs presented moderate positive association and significant correlation (with 5% significance): D2 (boards and audit) and D4 (Meeting) (0.545); D3 (Regulatory standards) and D4 (Meeting) (0.631). Thus, as there is an increase in D4 score, there is also an increase in D2 and D3 scores. The D2 (boards and audit) and D5 (SROI) dimensions also presented a moderate reverse association (-0.406), but not significant at 5% of likelihood. In short, as D2 scores increase, D5 set of variables (dimensions) decreases. Other dimension pairs presented a poor association, with no significance at 5% of likelihood.

Considering the results presented by the correlations, Bartlett's Sphericity test was significant with 5% of significance (p-value < 0.05). According to Johnson and Wichern (1998), this result ensures the relevance and reliability of the results that will be presented by principal component analysis (PCA) and factor analysis (FA) [19].

Based on the Principal Component Analysis (PCA) two components were selected, which, considering the dispositions of Ferreira (2008) and Jollife (2002), consist in the analysis of principal components that achieved an eigenvalue equal to or higher than 1, that is, the accumulated ratio of total variance explained by the two first principal components is equal to or higher than 70% [20],[21].

Through the referred analysis, it was noted that the first principal component was responsible for the higher explanation percentage of the total rating variability for the 5 dimensions (44.02%) followed by PC2 (31.87%).

The Biplot graph presented in Picture 1 presents the associations between each pair of principal components that were considered in the analysis. In this scatter graph, each point represents scores of the principal components of each researched individual. Also, the arrows in this graph represent the intensity and the direction of the influence for each dimension, as follows: (1st) arrow parallel to the axis of each principal component represents that this variable has bigger influence in this PC, and (2nd) the direction of the arrow indicates if such influence is direct (direction equal to the increase of PC values) or reverse (direction opposite to the increase of PC values). The direct influence of a variable under a PC represents that individuals with high values for such variable will have high values in the referred PC. On the other hand, the reverse influence of a variable under a PC represents that individuals with high values for such variable will have low values in the referred PC [21].

Picture 1 presents D3 (Regulatory standards) and D4 (Meeting Standards) exercising a higher influence in the generation of PC1, and such influence is reverse. Clubs that attributed higher ratings in all questions about conduct and conflict of interest and stakeholders presented a low PC1 score.

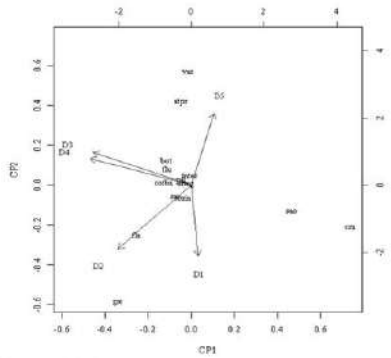
Thus, it is noted that the majority of the clubs achieved intermediary values for PC1. However, São Paulo and Cruzeiro clubs presented the highest values for PC1 (Picture 1(a)) and, consequently, those were the clubs with lowest ratings attributed to conduct and conflict of interest and stakeholders.

As for the results on PC2, it is noted that D5 (SROI) dimension exercises a higher positive influence in the generation of such component and D1 (Transparency) and D2 (boards and audit) dimensions presented higher negative influence on PC2. Thus, PC2 represents a comparison between the ratings attributed to the questions for SROI and the ratings attributed to disclosure and boards and audit.

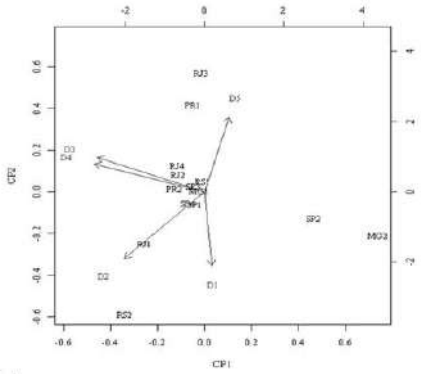
Thereby, it is noted that the majority of the clubs achieved intermediary values for PC2. However, Vasco and Atlético Paranaense presented higher values for PC2

https://dx.doi.org/10.22161/ijaers.69.21 *ISSN: 2349-6495(P) | 2456-1908(O)*

(Picture 1(a)) and, consequently, those were the clubs with the lowest ratings attributed to 'Transparency' and 'boards and audit' and with the highest ratings to SROI.



Picture 1a. Clubs *versus* State
Biplot graph to each pair of principal component (pc), in which individuals are named after (a) the club and (b) the state they belong to.
Source: Authors



Picture 1b. State
Biplot graph to each pair of principal component (pc), in which individuals are named after (a) the club and (b) the state they belong to.
Source: Authors

Grêmio and Flamengo were the ones with the lowest PC1 and PC2 values (Picture 1(a)) and, consequently, presented high ratings attributed to 'Regulatory Standards' and 'Meeting'; they also had the highest ratings for 'Transparency' and 'boards and audit' and the lowest ratings for SROI. However, it is noted that there is no relation between the scores of principal components and the States represented in the study (Picture 1(b)).

Using the technique of principal components, a factor analysis was also performed with varimax rotation and cluster analysis in order to establish the groups of dimensions with similar scores if compared to the total researched clubs. Table 2 presents factor loadings of the two first factors in common that, similarly to principal components, respectively represent 44.02% and 31.87% of the total data variability. Through both factors, it is noted that the highest factor loadings were observed in Factor 1 with the D3 (Regulatory Standards) and D4 (Meeting) dimensions, and in factor 2 with D1 (Transparency), D2 (boards and audit) and D5 (SROI) dimensions.

Thus, two groups were created: group 1 (D3 and D4) and group 2 (D1, D2 and D5). The same result was found in the analysis of principal components (Picture 1).

Table 2: Factorial Loads Obtained by Factor Analysis

Dimensions	D1	D2	D3	D4	D5
Factors					
Factor 1	-0,269	0,470	**0,963**	**0,963**	0,000
Factor 2	**0,662**	**0,808**	0,000	0,000	**-0,742**

Note. Numbers in bold represent factor loadings that are, in components, bigger than 0.5.

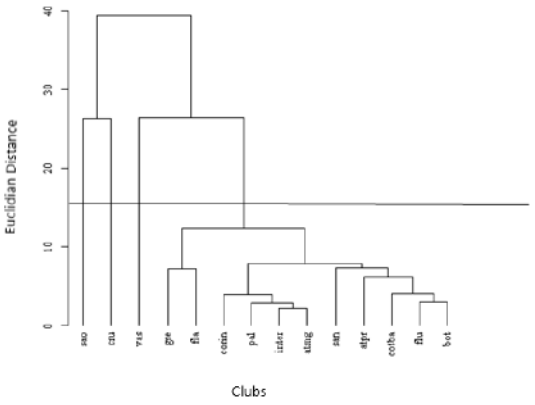
Source: Authors

The cluster analysis has been performed, and the clustering method chosen was the centroid method with dissimilarity measure equal to the Euclidean distance. The cluster analysis performed was considered efficient, since it achieved a cophenetic correlation coefficient equal to 0.9362 (near 1,[22]).

Taking into account the greatest variation that occurred between the Euclidean distance as cutting point [20], the clubs were divided into four groups (Picture 2(a)): Group 1 (Grêmio, Flamengo, Corinthians, Palmeiras, Internacional, Atlético Mineiro, Santos, Atlético Paranaense, Coritiba, Fluminense and Botafogo), Group 2 (Vasco), Group 3 (Cruzeiro) and Group 4 (São Paulo). Such result indicates that the clubs with fewer similarities with other clubs were: Vasco, Cruzeiro and São Paulo. It is important to note in the graph that, when clubs are renamed by their State of origin (Picture 2(b)), there is no relationship between groups and States.

Thus, two groups were formed: group 1 (D3 and D4) and group 2 (D1, D2 and D5). This same result was noted in the analysis of principal components (Pictures 2a and 2b)

Picture 2a. Clubs' cluster
Dendrogram obtained by clubs' cluster analysis, named by (a) its own name and (b) its home state.
Source: Authors.



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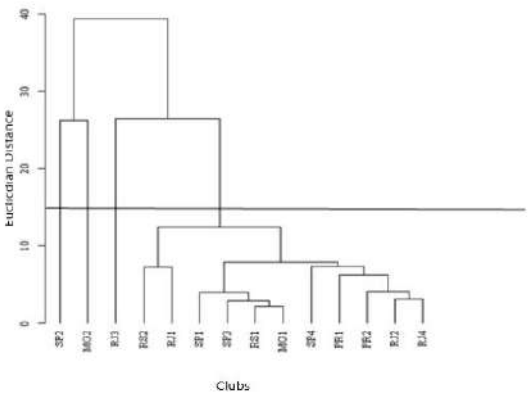

Picture 2b. State's cluster
Dendrogram obtained by clubs' cluster analysis, named by (a) its own name and (b) its home state.
Source: Authors.

Considering the 14 clubs with largest revenues in the Country (Table 1), the following results are noted for the purposes of this work:

4.1 Regarding the main governance characteristics of the researched soccer clubs

Data shows the prioritization of Transparency, that is, disclosure of information to investors and Board members. The information prioritize the compliance with CFC Resolution nº 1.429, (2013) and CFC Resolution nº 1.005 (2004) [23],[24]. However, it is important to point out that explanatory notes are not being fully disclosed, jeopardizing the compliance with CFC Resolution nº 1.429 (2013), which highlights rights, revenues and existing contracts with athletes and other tax and legal obligations [23]. Such aspects are mentioned by Walters and Tacon (2010), who indicate that transparency about what occurs in the organizational environment, whether internally or externally, is critical for management, since knowing all data and information is primal [25]. The quality with which managers run their teams, not only in the field, but also when managing their revenues, directly impacts their success [26]. Such data, according to Melo Filho (2011), may refer to the applicable salary caps, the balance between revenue and expense, as well as other parameters that indicate the club's good financial management [27].

The lack of transparency is noticeable in greater or lesser scale in all clubs, according to accounting statements disclosed at the official webpage of each association, as well as other investigation data. Lack of sufficient information, as seen, hinders the club's credibility before current partnerships and prospects.

4.2 Regarding the interference of internal stakeholders

The prioritization of the internal agent, the partner, either as director or supporter, was noted. Thus, other possible external stakeholders are not properly taken into account, such as governments, society and sponsors.

The attention to voting partners is limited to the election of decision-making body and board of executive officers; directors (Decision-Making Body and Fiscal Council) and officers (some of them receive compensation) are responsible for maintaining the club's administrative and operational structure. The Board of Directors does not exist in 12 of the 14 clubs studied, except for Grêmio/RS and Clube de Regatas Flamengo/RJ, which presented a properly formalized and institutionalized board.

The ombudsman, an important in the relationship with external stakeholders, prioritizes the relationships with partners, limiting itself to the management of operational demands. It agrees with the statement by Parent and Deephouse (2007) and Sotiriadou (2009), which emphasizes that clubs generally try to attribute greater importance to the organization's internal participants [28],[29].

4.3 Regarding the interferences observed in the governance practices in the current management model, it is noted that:

1) Registered supporter: has institutionalized rights and duties; acts through direct election in the composition of board of members, legitimizing, in a certain way, their participation in the club's management;

2) Decision-Making Body (DMB): is the body through which the associates may jointly manifest themselves, and they are responsible for voting the strategic planning, in addition to matters under their responsibility, such as discussing and voting the annual budget, assessing the trial balance sheets, deciding on financial proposals, supervising members of the DMB, the Advisory Board (if applicable) and Fiscal Committee, as well as other committees. For Grêmio/RS and Clube de Regatas Flamengo/RJ, which have a Board of Directors, the DMB shall resolve on their proposals, as well as decide on budgetary supplementation;

3) Board of Directors (Grêmio/RS and Clube de Regatas Flamengo/RJ): among various supporting activities to the (legislative and executive) management, it is responsible for providing the Fiscal Committee with requested information and documents, as well as for resolving on financial and budgetary matters;

4) Fiscal Committee: supervisory board for the club's financial administration, through periodic analysis and issuance of technical opinions;

5) Advisory Board: the frequency of this board's actions was not verified for the clubs analyzed in the sample;

6) Executive Management: paid position for areas such as Legal Marketing, Planning, Business, Soccer, etc.

https://dx.doi.org/10.22161/ijaers.69.21 ISSN: 2349-6495(P) | 2456-1908(O)

According to KASZNAR and FILHO (2002), the figures suggest that clubs' managers do not seem to understand their importance to the clubs' supporters, as well as to the society in general, whether by loving the club or by their relevance within the sports productive chain. [30],[31], [32],[33].

4.4 Regarding the interference of external stakeholders

According to Andrade and Rossetti (2007), the administration literature is full of examples evidencing the presence and interference of groups of interest (internal: employees, officers, directors and auditors; external: suppliers, consumers, organized and civil society, government, etc.) together with the organization's routine, such as: Barney & Hesterly, 2007; Johnson, Scholes, & Whittington, 2011; Jones, 2004; Lacombe & Heilborn, 2008; Motta & Vasconcelos, 2006; Peng, 2008; Sobral & Peci, 2008; Stoner & Freeman, 1995, among others, who seek to understand the engagement of these players in the organizations' management, their level of influence in decisions, as well as their impact [34], [35], [36], [37], [38], [39], [40], [41], [42].

The external stakeholders of soccer clubs exercise an influencing and determining role in the preparation and organization of championships (confederations and federations), in the increase of the clubs' revenues (media/sponsor/supporters/clients) and in the regulation of their tax and labor obligations (government), as follows:

• Federal Government: interference in terms of (tax and labor) debts of Brazilian soccer clubs. In this regard, Provisional Measure nº 671 (2015) provides for the management modernization and Brazilian Soccer's Tax Liability, directly impacting the clubs' management and its relationship with supervisory and regulatory bodies (tax relationships, taxes, labor relationships, sponsorships, etc.), having the Brazilian Soccer Confederation as partner of the clubs (with representativeness and autonomy to rule on domestic soccer) [43];

• Brazilian Football Confederation (CBF - Confederação Brasileira de Futebol): influences the organization and performance of the main championships in the country (Brazilian Championship - Brasileirão – A/B/C/D Series; Brazilian Cup – Copa do Brasil, etc.); it is the entity that represents the Brazilian soccer in the continent and globally; it acts as legislator and manager, at State level, it is represented by the respective federations;

• State Federations: located at each of the federation's states, they are responsible for organizing and executing regional championships (Rio Grande do Sul's Championship, Rio de Janeiro's Championship, São Paulo's Championship, Minas Gerais' Championship, Paraná's Championship, among others), providing conditions so that smaller clubs are allowed to survive, at least for some months during the year; they also act as intermediary between clubs and the CBF, regarding the legislative and administrative aspects involving the club;

• Television media: through funds individually negotiated with the clubs, it is currently one of their main sources of revenue. Its influence is noticed at the scheduling of matches during hours that are not favorable to the supporter, such as at 10:00 pm, in the middle of the week, which aims to primarily meet the television channel's schedule and their commitment with sponsors, not directly extending its performance to the club's management.

• Sponsors: after the 2014 World Cup in Brazil and the construction of big stadiums, the clubs started seeking stronger sponsors (financially and with brand equity) to assign their naming rights for a limited time to their arenas. For example, Palmeiras' Multipurpose Arena/SP, named Allianz Parque, as a result of Palmeiras' partnership with an insurance company. It is also important to emphasize that the clubs seek sponsors to print their brands in the team's uniforms, displays at the stadium, among others. However, the relationship between club and sponsors is limited to the exchange of image and strength of the brand, upon pecuniary exchange.Regulatory agents (federal government, federations and confederations) and the local community (sponsors, supporters and clients) are crucial to the club's activities, thus, generating their influence and urgency power [15], [44],[45].

Thiel and Mayer (2009) consider stakeholders part of the club's decisions, however, they state that their interests shall not supersede the clubs' purposes [47].

4.5 With respect to the transparency of control and management information instruments adopted by the clubs and their contribution to good governance practices

Absence of an Audit Committee, the (decision-making and fiscal) boards are responsible for superficially acting in such process. In 86% of the researched clubs, there was no Board of Directors, except for Grêmio/RS and Clube de Regatas Flamengo/RJ. Pursuant to the Brazilian Rules of Corporate Governance, this board has the duty to be the connection between ownership and management, in order to guide and monitor the relationship between management and other stakeholders, since it has a key role in the decision-making process and strategic guidance, which are essential elements for developing good governance practices [47].

According to the IBGC (2009), the role of the audit committee is to verify the financial statements and

https://dx.doi.org/10.22161/ijaers.69.21 *ISSN: 2349-6495(P) | 2456-1908(O)*

their transparency against the company's current status [48].

Thus, the expansion of Brazilian soccer clubs' commercial activities goes primarily through good governance practices driven by transparency and compliance with the market's demands.

The Board of Directors, an independent audit company or the fiscal committee may comply with some of these demands. The adoption of such practices allows for the expansion of the clubs' credibility and conversation, according to [15].

Although managers are aware of the importance of instruments that may assist in the clubs' control and management, no concrete action has been taken by them [48].

The investigation suggests that governance initiatives oriented to the club environment context may cause changes as to how clubs are perceived and managed, whether through better allocating funds or adjusting the organizational structure, as well as through the implementation of a clear management model, adopting the dimensions of the Brazilian Governance Institute. In this regard, Table 3 shows a contribution to studies on sports governance, since it aims to address the gap noticed between the management of good governance practices (IBGC) and the current management of the referred clubs, as follows:

Table 3: Sports governance model to Brazilian soccer clubs

Dimension	Characteristics
Transparency	. Adoption of professional management at all executive levels of the club, as well as in the mediation of other councils and committees, which count on the partners and advisors' participation. . Usage of standard documents, such as annual and financial reports required by law (among others NBCT 10.13 and Resolution CFC 1.005/2004), which intend to meet the club's characteristics and requirements, as well as the other market agents (prioritizing governance items and the current legislation) . Transparency and frequency in communicating financial reports, as well as contracts (partners, sponsors, athletes among others) to all stakeholders involved. . Definition of management and control procedures; establishment of an internal (formally established and operating) and external (staffed by professionals without any identification to the club) audit.
Assembly/Counseling and Audit	. Inclusion of Ombudsman as assistance entity of the Hearing Committee, which takes over the auditing and validation of activity results of various hierarchy levels (assembly, counseling and executive management). . Requirement of the Executive Board, replacing the Management Board, meeting the requirements of governance procedures, as well as professionalizing the mediation between the General Assembly and the Deliberative and Fiscal Board. . Formalization and frequency of the internal inspection activities on the clubs through the effort of the internal audit (formally established and operating) as well as the external audit (staffed by professionals not connected to the club), aiming to create performance indicators that reflect on conducting the governance standards that meet the sport particularities.
Mediation Standards	. To increase the number of external participants in the Councils and Committees (supporter, sponsor, confederation, auditors and financial managers not connected to the club) aiming that the clubs professionalize the ways of conducting and solution of conflicts. This factor becomes a regulatory framework for club interests because it focuses on political impartiality in the management process.
SROI (socioenvironmental actions)	. To define performance indicators that encourage the good behavior on socioenvironmental practices which should meet health, education, and sport needs through specific actions (extension projects that meet the socioeducational demand, in conjunction with the ultimate goal, the professional athlete) that result in quality of life improvement of that very environment. . Requirement of a socioenvironmental report as a way of proving the investments made by the club and, consequently, its impact on society.

Source: Authors.

The reflection about the validation of governance aspects and good management practices, established based on macro and microeconomic indicators that meet the needs of the sports segment, contributes to further developing and understanding the matter.

V. CONCLUSION

The main contribution of this work is the identification of forms to adopt governance practices according to the analyzed factors, that is, their commercial and social relations with different partnerships. It is mentioned that the commercial interest and the interest in meeting demands from different audiences may be greatly impacted with transparency of information, the management by the boards and the enforcement of social actions and rules.

External contexts, such as debates conducted in Europe about the clubs' direction, have influenced the critics regarding bad practices being performed in Brazil. However, the search for external management models, which attribute greater administrative transparency to clubs in their relationship with new investors, have contributed for the consolidation of a better image of Brazilian clubs abroad, as well as for a possible closer relationship with their supporters.

However, it is necessary to point out that, through the analyzed data, there are indications that the capacity for governance structuring and main strategic decisions on the researched soccer clubs are subject to systematic interferences from stakeholder groups. An example of such are the boards, which restrict the manager's autonomy, as well as relationship strategies with excessive emphasis in registered supporters (programs that have no relation to the society and its needs), which relegates the supporter-consumer to a background (market actions meeting the supporter-client needs – broadly emphasized in European clubs – were not observed). Another negative factor pointed out is the permissive interference of groups elected in the appointment of executive positions, with no direct relation to the qualification required to exercise the role. Based on such information, it is possible to imply that soccer clubs grant opportunities guided by personal interests, hindering the partnerships' reliability and, as a result, the fund raising process, affecting the soccer business dynamics.

When considering the search for new opportunities for the survival of soccer clubs through activities of economic sustainability, there is a systemic need for changes, since it involves the clubs' governance and commercial activities, as well as relationships with all stakeholders, including other sports organizations, sponsors, government, press,

https://dx.doi.org/10.22161/ijaers.69.21 *ISSN: 2349-6495(P) | 2456-1908(O)*

supporter-consumer, among others. It is understood that such relationships expand the proposals of change and adjust actions related to legislation and good governance practices, with the purpose of meeting economic and financial vulnerability of Brazilian clubs through effective administrative solutions [48].

It is important to point out that Proni and Zaia (2007) emphasize the impossibility of a single management model, which would require from the manager a deep analysis of the organizational context of each club, as well as a reflection about the best form of conduction [26].

Thus, this work, when describing the current governance setting, suggests actions for the adjustment of soccer clubs to the needs of investment and consumer markets, especially by improving the relationships with different direct partners, in addition to the adjustment of their governance and management structure.

Based on the analysis of the data collected in this research and works of Alves and Pieranti (2007) [49] and The Football Association (2005) [50], the following practices are suggested in order to expand the possibilities of greater reliability for the clubs' commercial activities:

1) Complying with legal demands and mediating conflicts between different political groups comprising the bases that enable the management of sports entities;

2) Addressing the partners' perspectives by allowing them to vote and have their representative at the boards;

3) Making the club's performance clear to intermediaries with economic and financial interests, as well as sponsors;

4) Promoting strategies and actions that include the wishes of the community and the professional qualification of amateur athletes and social projects;

5) Encouraging the union between the boards, as well as voluntary or professional stakeholders, with different competences and skills, so they may contribute to the monitoring (Fiscal Council and External Audit), control (Board of Directors) and management of sports processes.

It is necessary to emphasize the distance between the power of such clubs' trademarks and the credibility of their action, which results from the incompetency and lack of commitment of current managers with subsequent managers, which do not prevent the proposition of conceptual aspects allowing a better reflection based on current management models [53],[54].

However, it is important to point out the future theoretical and research possibilities regarding the concept of governance under the perspective of its practices divided into sectors. With this research, it was possible to verify strong indications of historical influence in the holders of power and their practices on matters related to the studied topics, such as transparency information instruments and administrative models with the participation of stakeholders.

As a limitation, this study may not be generalized to other Brazilian soccer clubs, making the re-application of this study necessary for further generalization. Future works, under this scope, must verify a possible extension of results upon the inclusion of other clubs that were not researched in the sample.

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https://dx.doi.org/10.22161/ijaers.69.22 ISSN: 2349-6495(P) | 2456-1908(O)

Credit Concession in the Brazilian Banking Sector in the Period of the International Financial Crisis

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Abstract**—** *The international financial crisis of 2008 was triggered in the United States and affected the global financial scenario, since it caused a lack of liquidity in the market and credit was restricted. In this context, the objective of this research was to compare the evolution of credit granted by public and private banks in Brazil before and during the crisis, covering the years 2002 to 2009. The study was conducted through a bibliographic and quantitative research, based on data obtained from the Ministry of Finance and the Central Bank of Brazil. It was found that from September 2008 to December 2009, the growth of credit operations of private institutions was 3.91% compared to a 55.62% increase in public institutions.*
Keywords**—** *Credit Concession; Financial Crisis; International Financial.*

I. INTRODUCTION

Current economic relations make countries interdependent. For this reason, the crises that begin in one country can spread to others. The Great Depression, which occurred in 1929, stagnated the U.S. economy for years, and demonstrated the fragility of the banking system and the risks present in it, due to the asymmetry of information, which indicated the need for financial regulation (FELIPPI, 2011). From the 1970s, the Keynesian economic model, which advocated government intervention, gave way to the neoclassical economic model, which preached a neoliberal ideology, with reduced participation of the state and deregulation of the financial market in search of efficiency and self-regulation (BRESSER-PEREIRA, 2010).

Banking crises are reflected in banks' balance sheets, either by a crisis of investor confidence or by bank insolvency (FELIPPI, 2011), which may reduce the credit available to economic agents, hindering the resumption of economic growth. Credit becomes relevant in periods of recession, because according to Araujo and Cintra (2011), the granting of credit can contribute to minimize the effects of a financial crisis. The banking sector, taking and lending resources to society, is fundamental to maintain the proper functioning of the financial flows of the population, companies and government (BOTELHO, 2007).

In this study, the objective was to compare the evolution of credit granted by public and private banks in Brazil before and during the crisis, covering the years 2002 to 2009. To this end, we analyzed the behavior of credit in banks established in Brazil, of public and private capital, both foreign and domestic, in the years in which the country faced the effects of the financial crisis, in comparison with the years prior to the crisis, when economic activity was stable. During the period of the crisis, the Brazilian government took a series of countercyclical measures aimed at recovering economic activity (MINISTRY OF FINANCE, 2011), and it will be verified whether among these measures, there was an incentive to credit through government-owned banks.

II. THEORETICAL REFERENCE

2.1 The International Financial Crisis

The international financial crisis, also known as the subprime crisis, which began in August 2007 in the U.S., is considered the biggest financial crisis since 1929, when the New York Stock Exchange crashed (CAVALCANTE JR., 2012). Financial crises cause a sudden change in asset prices, followed by moments of panic, where irrational behavior prevails (KRUGMAN, 2010).

In order to understand the financial crisis caused by the devaluation of subprime mortgage derivatives in the United States, it is necessary to verify the evolution of the American residential construction market (GONTIJO, 2008). Also according to the author, loans for residential

https://dx.doi.org/10.22161/ijaers.69.22 ISSN: 2349-6495(P) | 2456-1908(O)

acquisition provided to borrowers who were unable to provide an entry value, or who could not prove income, or both, were defined as subprime. The credit promoting institutions understood that if the borrower could not comply with the payments, his residence, which was the object of the financing, would be taken by the creditor and sold in the market, which was heated, envisioning the valuation of the properties given as collateral (GONTIJO, 2008).

With the market heated and the real estate increasing its value, borrowers had the possibility to refinance them (GONTIJO, 2008). According to Guttmann (2008), financial innovations related to real estate ownership, such as mortgage refinancing and loans for the purchase and renovation of real estate made it possible to turn capital gains into cash. This becomes possible without the need for the owner to sell his home, since property prices were rising (GUTTMANN, 2008). Until the year 2006 this subprime market had a good functioning (GONTIJO, 2008). However, in the summer of 2006, property prices suffered fall, resulting from the increased supply of housing (GONTIJO, 2008). As this market was being valued, with gradual increases in house prices, the supply of homes began to increase, because the market was attracting investments, and this increase in supply led to falling prices (GONTIJO, 2008). Financing and refinancing of subprime mortgages became scarce due to the retraction in U.S. property prices, generating a real estate crisis (FELIPPI, 2011).

The borrowers of housing loans classified as subprime depended on the valuation of the property to migrate to mortgages with prime rating, by the latter presenting lower interest rates (GONTIJO, 2008). Since there was no expected appreciation of the property, then not allowing the transition to a lower interest rate, many borrowers could not refinance their properties, and presented delays in instalment payments (GONTIJO, 2008). The real estate suffer devaluation with the growth of default on mortgages and the vacancy of these homes, creating a vicious circle that reaches the housing market as a whole, including in prime mortgages (FELIPPI, 2011). So much so that in March 2008 about 8.8 million mortgages were with a balance higher than the value of real estate, which ended up encouraging the non-payment of the loan by the borrowers (GONTIJO, 2008).

With the interconnection between markets, banks are also affected by this economic shock (FELIPPI, 2011). According to Mazzucchelli (2008), the crisis was preceded by the fragility of regulation and the relaxation in the perception of risks, which led to a wave of speculation with disastrous consequences. The credit market suffered an exogenous shock from the American real estate market, where public policies contributed to an inadequate pricing of mortgage credit risk (FELIPPI, 2011). Doubtful financial operations spread, leveraged by credit growth, which occurred both in the 2008 crisis and in the 1929 crisis (MAZZUCCHELLI, 2008).

Mazzucchelli (2008) argues that with the worsening of the crisis the intervention of governments was broad and immediate, abandoning the liberal economic thinking preached until then, which argued that markets were efficient or self-regulated, which changed with the advent of the crisis. The states assumed responsibility for defending financial institutions, providing liquidity, fully guaranteeing deposits, reducing basic interest rates and trying to avoid further credit contraction (MAZZUCCHELLI, 2008). Still according to the author, some governments acted with a higher degree of correctness, as was the case in England, or a lower degree of correctness, as in the United States. The crisis was no longer aggravated by the immediate and continuous injection of public resources, given the preference for liquidity, with a flight to public debt bonds, especially American (MAZZUCCHELLI, 2008).

The action of governments, classified as Keynesian, was to recover the credit-income cycle, even though it was necessary to nationalize, even partially and temporarily, a significant part of the financial system (MAZZUCCHELLI, 2008). The performance of central banks was fundamental for the recovery of the economy. The US Central Bank (CB) and the European Central Bank (ECB) injected US$ 3.2 trillion into the money markets between July 27 and September 12, 2007 (FREITAS; CINTRA, 2008).

In Brazil, the year 2007 was marked by large projects in Brazil, both in the public and private areas, and this economic optimism extended to the following year (DULCI, 2009). It was expected that the country would suffer only a residual influence of the crisis, and that there was discussion about the detachment of the so-called emerging economies, such as the Brazilian one, in the face of the crisis in the central economies (DULCI, 2009). The aim was to verify what would be the degree of detachment, given the different characteristics and circumstances of the Brazilian economy. The year 2008 ended with recession, increased unemployment and the threat of deflation (DULCI, 2009).

Banks worked with other unregulated financial institutions, and the effects of the crisis that began in the United States extended to banking institutions in other countries, demonstrating the fragility of the banking system (FELIPPI, 2011). Banks raised the requirements for guarantees in the granting or renewal of credit lines, in

https://dx.doi.org/10.22161/ijaers.69.22 ISSN: 2349-6495(P) | 2456-1908(O)

addition to increasing interest rates on active operations in the last quarter of 2008 (FREITAS, 2009). This increase was due to an increase in the cost of funding for banks and an increase in the risk spread due to increased uncertainty, aggravated by losses resulting from operations with dollar derivatives (FREITAS, 2009).

Several countercyclical measures were taken by the State between 2008 and 2010, such as the increase in the release of funds for financing through the Economic and Social Development Bank (ESDB). My Home My Life program, encouraging the acquisition of own housing mainly for the lower-income population, increase in the limit of payroll loans to retirees (MINISTRY OF FINANCE, 2011). According to the Central Bank of Brazil (2010), credit operations grew again in 2010, after the effects of the financial crisis. The dynamism of domestic demand contributed to this, benefiting from the recovery of the labor market and the positive expectations of economic agents (Central Bank of Brazil, 2010).

2.2 Bank Credit

The Brazilian banking system has been undergoing changes. The country had a Central Bank only in 1965, with the approval of Law 4,595 of December 31, 1964. Before that, the National Treasury, the Superintendence of Currency and Credit (SUMOC) and the Bank of Brazil exercised the functions of the Central Bank (ALMEIDA, 1997). In the mid-1990s, the banking system underwent significant transformations, such as the reduction in the number of financial institutions, the entry of international banks, the adhesion to the Basel I agreement, the integration of the domestic and international banking systems and the implementation of the Real Plan (ARAUJO; CINTRA, 2011).

Banking institutions operate with surplus agents, who have resources, and deficit agents, who take resources, acting as an intermediary in this relationship (YOSHIDA JR, 2014). Deposit-taking and lending are considered the two main functions of commercial banks (YOSHIDA JR, 2014). For this reason, banks define liquidity and credit supply conditions in the economy (SARAIVA; PAULA, 2011), and interest rates act to balance this relationship between supply and demand (ARAUJO; CINTRA, 2011). Banks have evolved this intermediation, mainly in the last 30 years, covering investment funds, securitizations, capital markets and regulatory arbitration instruments (FELIPPI, 2011).

The financial sector is strategic to a nation's economy, given the global economic interdependence (BUTTON, 2007), and financial crises initiated in one nation can spread to other trading partners. Financial crises affect asset prices in the economy and do not necessarily affect credit distribution (FELIPPI, 2011). The decrease in the granting of credit may occur due to the reduction in economic activity, which causes a decrease in demand for loans, or due to liquidity or capital problems of institutions that are intermediating the credit process (YOSHIDA JR., 2014).

However, with the financial crisis of 2008, the granting of bank credit is affected. The regulatory apparatus already present in the financial system in 2007, such as international agreements aimed at preserving market liquidity, was not sufficient to prevent the paralysis of the credit market (FELIPPI, 2011), and decentralized supervision structures demonstrated fragility with the crisis (FARHI; CINTRA, 2009).

After the subprime crisis and with the application of Basel III, the relationship between bank capital and the granting of credit gains space for further discussion (YOSHIDA JR, 2014), since the regulatory tripod, composed of the creditor, deposit insurance and minimum capital requirement was not sufficient to avoid the crisis (FELIPPI, 2011). Then, banks began to have stricter regulations to contribute to financial stability, avoiding systemic risk, requiring a minimum capital requirement in order to avoid excessive leverage (FELIPPI, 2011).

Public banks foster economic development, especially in the long term, where private banks practically do not operate (ARAUJO; CINTRA, 2011). Credit received government incentives through the reduction of interest rates of public banks, especially in the two main ones, Bank of Brazil (BB) and Federal Savings Bank (FSB), which was observed during the financial crisis (YOSHIDA JR, 2014). The Economic and Social Development Bank (ESDB) is one of the largest development institutions in the segment that operates in the world, BB is the institution with the largest volume of Brazilian rural credit and CEF represents the institution that most fosters the housing system in the country (ARAUJO; CINTRA, 2011).

In the fourth quarter of 2008, with the global financial crisis, private banks retracted credit, which was sustained by public banks (ARAUJO; CINTRA, 2011). The Brazilian government sought to assist in the resumption of economic activity through measures such as increasing financial contributions to public banks, reducing the requirement for compulsory deposits by banks and reducing basic interest rates (MINISTRY OF FINANCE, 2011). Public banks act in an anti-cyclical manner as to the supply of credit (ARAUJO; CINTRA, 2011). Therefore, the financial crisis demonstrated that public banks contributed to the resumption of economic activity in Brazil, filling the gap left by private banks, which contracted credit due to risk aversion (ARAUJO; CINTRA, 2011).

https://dx.doi.org/10.22161/ijaers.69.22 *ISSN: 2349-6495(P) | 2456-1908(O)*

III. METHODOLOGICAL ASPECTS

This research is classified as applied, regarding the nature (COLLIS; HUSSEY, 2005), and as exploratory, regarding the objectives (COOPER; SCHINDLER, 2003). Considering the technical procedures, it is bibliographic (GIL, 2002), with research in articles, dissertations and theses obtained in the CAPES database.

Regarding the approach, it is a quantitative research (MARCONI; LAKATOS, 2009). The database of this study was extracted from reports issued by the Ministry of Finance and the Central Bank of Brazil. The period analyzed was from 2002 to 2009, in order to verify the granting of credit before and during the international financial crisis of 2008.

The objective was to compare the volume of credit granted by public and private banks during the financial crisis, covering the years 2008 to 2009. In order to make a comparison with the period prior to the financial crisis, data for the years 2002 to 2007 were analysed.

The sample covers the 50 largest financial institutions in the National Financial System, classified into public and private capital.

The evolution of the monetary volume of credit granted in Brazil was obtained in millions of real during the period studied. It was also analyzed how much the credit granted by public and private financial institutions represented a percentage of the total credit granted annually in the country.

IV. PRESENTATION AND ANALYSIS OF RESULTS

The government's actions were aimed at resuming economic activity in the country (MINISTRY OF FINANCE, 2011). For the implementation of many of the anti-crisis actions, the government acted through public financial institutions, where the participation of Brazilian Bank (BB), Federal Savings Bank (FSB) and Economic and Social Development Bank (ESDB) stand out, as can be seen in Table 1 (CENTRAL BANK OF BRAZIL, 2009). Table 1 shows the evolution of the credit operations of these institutions, which are the three largest public financial institutions in the National Financial System (NFS).

Table 1 Total credit operations of the three largest public financial institutions of the NFS in millions of real

Financial Institutions	Dez/2002 (R$)	Dez/2004 (R$)	Dez/2006 (R$)	Dez/2007 (R$)	Set/2008 (R$)	Dez/2008 (R$)	Dez/2009 (R$)
BB	51.470	74.844	113.869	138.849	175.613	190.888	261.779
FSB	19.643	25.564	41.220	50.798	63.364	73.162	115.516
ESDB	44.924	54.094	67.121	74.471	88.409	104.620	153.809
TOTAL	116.036	154.502	222.210	264.118	327.386	368.670	531.104

Table 1 shows the evolution of credit operations in the three largest Brazilian public institutions. In the seven-year period, from December 2002 to December 2009, there was an increase of 508.61%, 588.08% and 342.38% in the volume of credit granted by BB, FSB and ESDB, respectively (CENTRAL BANK OF BRAZIL, 2009 In the case of ESDB, these are direct operations, granted with reduced interest rates, for specific segments that it intends to encourage (CENTRAL BANK OF BRAZIL, 2009). According to Freitas (2009), in order to offset the reduction in credit by private banks, public banks increased and created new credit lines.

We highlight the two-year period from December 2007 to the same month of 2009, when the increase in credit was more pronounced. The growth in BB, FSB and ESDB operations was 188.54%, 227.40% and 206.54%, respectively (CENTRAL BANK OF BRAZIL, 2009). FSB and ESDB more than doubled the credit provided in these two years. It is observed that the growth of these institutions in the five previous years was 269.77%, 258.61% and 165.77%, and the ESDB presented a lower growth in these five years than in the two years in which the country was going through the crisis (CENTRAL BANK OF BRAZIL, 2009). Long-term operations over five years are shown in Figure 1 for 2010.

More than half of the long-term operations are provided through the Economic and Social Development Bank (ESDB), i.e. 59.82%. Adding its participation together with CEF and BB, it has a total of 86.63% of the operations with a term above five years in 2010 granted by these three public financial institutions (MINISTRY OF FINANCE, 2011).

Freitas (2009) states that private banks had a conservative attitude in the face of the international crisis, causing a movement of portfolio reallocation and credit retraction, contributing to the deceleration of economic activity. From December 2002 to December 2009, the share of private financial institutions in the Brazilian credit market decreased from 59.69% to 50.78% (CENTRAL BANK OF BRAZIL, 2009). On the other hand, the participation of public financial institutions increased from 37.96% to 46.56% in the mentioned period (CENTRAL BANK OF BRAZIL, 2009). However, the biggest difference is observed exactly in the period of the crisis, from September 2008 to December 2009, when the operations of private institutions went from 60.34% to 50.78% of the total market, while the credit granted by public institutions went from 36.94% to 46.56% of the total credit of the SFN (CENTRAL BANK OF BRAZIL, 2009).

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According to the Ministry of Finance (2011), public banks have taken the lead in granting credit since the critical period of the crisis. The decrease in the concession of credit has negative effects on economic growth (COLOMBINI, 2015).

From September 2008 to December 2010, credit offered by public banks grew 81.2%, while the balance of credit granted by private banks with national capital grew 35.4%, and by foreign private banks the increase was 20.2% (MINISTRY OF FAZENDA, 2011). Of the total credit granted in 2010, public banks accounted for 41.9%; private banks for 40.7%; and foreign banks for 17.4% (MINISTRY OF FAZENDA, 2011). With the country's economic situation stabilized as of 2010, the government eliminated fiscal stimuli and reduced government spending (MINISTRY OF FAZENDA, 2011).

V. CONCLUSIONS

When a country's economy is depressed, the population is subjected to negative effects, such as the bankruptcy of companies, low levels of production and unemployment. At times such as these, the government can use countercyclical measures to help the country achieve economic stability. This is how most governments acted through the effects of the 2008 international financial crisis, including the Brazilian one.

The government implemented countercyclical measures in Brazil in order to combat the effects of the depression that plagued the world economy, especially between 2008 and 2009. Among these actions, the one addressed in this paper was the expansion of credit granted by public financial institutions. Based on an analysis of the evolution of credit provided by public and private financial institutions as of 2002, it was found that the former showed robust growth at a time when the economy was in crisis, between 2008 and 2009, while the latter experienced the opposite, with a decrease in credit supply.

After analyzing the evolution of credit granted by private and public institutions, it was concluded that the latter, due to the expansion of credit at a time when the country was in depression, contributed to the Brazilian economic recovery. Credit stimulates an increase in consumption, which affects domestic demand, reflecting production and employment, thus contributing to economic growth. Thus, the importance of these institutions is emphasized, especially in times of crisis, since the government can act through them.

The theme provides continuity, and researchers are suggested to deepen the study by comparing the interest rates applied to credit operations between public and private institutions. It can also be analyzed the credit behavior after the recovery of economic activity, as of 2010.

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https://dx.doi.org/10.22161/ijaers.69.23 *ISSN: 2349-6495(P) | 2456-1908(O)*

Difficulties Facing Family Agriculture in Cacoal City, Rondônia/Brazil

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Abstract**—** *The present research aimed to investigate the difficulties faced by family farming in an area of Brazil. To this end bibliographic research was conducted and also field research using the data collection technique of interviewing family farmers of the Astra Association of Line 09 in Cacoal City, Rondônia/Brazil. The results of this work reveal that, despite the significant advances that family farming has made in recent years in the country and the state of Rondônia, it still faces certain difficulties; those identified in the research were the accessibility of credit, prices set by middlemen, poor quality roads for transporting production and the lack of specialized technicians when help is needed. Such problems require public policies to enrich farming enterprises, valuing farmers, promoting the stability of their conditions, and providing means of increased production, besides better structure and consequently a better quality of life.*

Keywords**— Family farming, Difficulties, Rural production.**

I. INTRODUCTION

Brazilian agriculture figures are among the highest in the world; it is characterized as a source of food and raw materials for many countries. Among its diverse practices,family farming production is a social form of production, well known for its material and immaterial contributions (DELGADO; BERGAMASCO, 2017).

In recent years, Brazil has significantly improved its ways of defining and understanding the characteristics and meaning of this social form of production. Its main source of leverage, among others, refers to the recognition of its enormous economic and social diversity, based on small landowners living in small communities whose families work with them on the land to produce goods for their own consumption and for sale (SCHNEIDER; CASSOL, 2017).

According to the Ministry of Agrarian Development (MDA) (2018), family farming in Brazil is the eighth largest food producer in the world, with annual revenues of US $55.2 billion.

According to the Ministry of Agriculture, Livestock and Supply (MAPA) (2018), the national agribusiness as a whole is responsible for 23.5% of the Gross Domestic Product (GDP), since 35% of this percentage, refers to the family segment, showing the importance of family farming in the country's wealth generation. Despite its salience, family farming faces four main difficulties: access to credit, the disadvantageous pricing of agricultural products, production outlets, and technical assistance. The absence of these factors, which may be essential for the economic and social growth of family farming, are a disincentive to

https://dx.doi.org/10.22161/ijaers.69.23 ISSN: 2349-6495(P) | 2456-1908(O)

production and marketing (ROCHA; SANTIAGO, 2013; NASCIMENTO et al., 2016).

With this in mind, the research sought to answer the following question: What are the main difficulties faced by family farming in the municipality of Cacoal, Rondônia? The objective in addressing this question was to identify the challenges faced by family farming in a rural association of this municipality, specifically,the four listed above. For this, the following specific research objectives were defined: (1) Learning about the forms of access to subsidized credit lines for family farming; (2) Identifying the difficulties encountered by rural farmers as regards the pricing of their products; (3) Discovering the strategies for transporting production; (4) Highlighting the forms of technical assistance used by farmers.

This study is intended to present insights into family farming and the difficulties that farmers face every day. It uses descriptive research drawn from bibliographic data and field data, collected through semi-structured interviews with thirty members of the Astra Association of Cacoal/RO, held on March 2019.

When the data were analysed, the profile of family farmers in the above association emerged, as did the characteristics of the properties they live in, together with the difficulties that family producers face with regard to access to credit, the pricing of products, the outflow of agricultural products and technical assistance.

II. FAMILY AGRICULTURE

Agriculture arose around 10,000 years before Christ, when the first species were domesticated, making food more easily available. Agriculture has evolved considerably since the appearance of the first villages and the nomadic reapers who became fixed-dwelling peasants. The green revolution in the nineteenth century was also a milestone for the progress of agriculture, bringing many benefits, such as machines, genetic improvements and chemical treatments which improved farmers' production and became part of their daily lives (COSTA, 2009; EDUCATOR'S MANUAL, 2014).

Lately, the production of agriculture in Brazilian has grown immensely. Family farming is a segment of it that has become prominent there and everywhere else. It is a form of production that where management and workers interact, is outstandingly diversified, preserves natural resources and the quality of life, uses complementary wage labor and requires immediate decisions that comply with the high-level demands of the production process and market variations. It is necessarily based on family work and cooperation (COSTA, 2009).

Several countries operate family farms, and of the 570 million farms in the world, 500 million are family farms. These are responsible for 70% of the world's agricultural production, making family farming fundamental for food security and rural development, and is an essential agent in the fight against hunger (LUCAS, 2014).

In the annual turnover from food production worldwide, China ranks first with $958.2 billion; next comes India with $353.6 billion; third, Indonesia with $125.4 billion; fourth, Nigeria with $84.9 billion; Brazilfifth, with US $84.6 billion, considering total agricultural production; sixth, Pakistan, with $64.7 billion;seventh,Japan with$56.9 billion; eighth, Brazil, including only family farming, followed by the US with $55.2 billion. Then comes Russia with $54.8 billion and finally Turkey in tenth place with $53.4 billion. This brings home how important family farming is worldwide (MDA, 2018).

The origin of the concept of family farming in Brazil is contemporary and fell into three major phases. The first concerned the acknowledgement of family farming marked by trade union movements and mainly due to the scholars who discussed the theme in the early 1990s, where it was the initially found in books which reported studies of the economic status of family farming. The second phase began in 1996 with the creation of the National Program for the Strengthening of Family Farming (PRONAF). This was extended to 2006, and referred to the institutionalization of family farming through Law 11.326 of 24 July 2006. This law characterized the family farmer and rural family entrepreneur as one who practises activities in rural areas which he does not own. The areas are larger than four fiscal modules; their families work with them; a minimum percentage of family income is earned from the farmer's establishment or enterprise and the establishment or enterprise s set up with the help of the family (SCHNEIDER; CASSOL, 2013).

The publication of data on the main source of agricultural information, the 2006 process data, is a recognition of the location and role of family farming in Brazilian rural development (SCHNEIDER; CASSOL, 2013).

Family farming is not predominant in livestock production, where 38% of the value of production and 34% of total revenues from Brazilian agribusiness (SCHNEIDER; CASSOL, 2013), but small farmers have

https://dx.doi.org/10.22161/ijaers.69.23 *ISSN: 2349-6495(P) | 2456-1908(O)*

been gaining ground in agribusiness and playing an important role in the country's economy, producing food and generating job opportunities, as well as the society around them (ORGANICS NEWS BRASIL, 2017).

The family farming and its place in Brazil today are represented in a way that considers the effectiveness of its struggles to affirm itself as a class, not only to have the work of the family acknowledged but also to confirmits loyalty to the internal market, consequently providing farmers with a high quality of life and increasing the adherence of rural producers to their land(PICOLOTTO; MEDEIROS, 2017).

III. FAMILY AGRICULTURE IN RONDONIA

The colonization of the present state of Rondônia has had three migratory phases. The first and the second began with the process of extracting rubber, primarily, as well as gold and drugs from remote parts of the territory. Rubber extraction predominated after World War II, when elastic gum was needed; this motivated Brazilian state to form policies for the migration of men to the region, not only for the Rondonian rubber plantations but also to collect Amazonian rubber (CUNHA, 2015).

The third phase was initiated by the opening of BR-364, a highway that allowed access to the state of Rondônia. Between 1970 and 1980 began the process of colonization with the arrival of migrants, mainly from the south, Paraná in particular, together withpeople from other Brazilian states, such as Mato Grosso, Mato Grosso do Sul, Espirito Santo and Minas Gerais; evidently, Rondônia was populated by several Brazilian regions. These migrants had the objective of acquiring a piece of land, where they would settle and intended to plant and cultivate (CUNHA, 2015; SILVA; BURGEILE, 2014).

Along with the opening of BR-364, new settlements were formed, leading to what is known as land grabbing: the accelerated and disorganized occupation of Union and private lands, without any legalization (CUNHA; MOSER, 2010).

Faced with this situation, the Federal Government took the initiative through the National Institute of Colonization and Agrarian Reform (INCRA) of creating by Decree-Law N° 1,110 of July 9, 1970 an autarchy linked to the Ministry of Agriculture which distributed plots of land to farmers, thereby regularizing land tenure, provided the plots were occupied and remained in production (CUNHA, 2015; CUNHA; MOSER, 2010).

The migration of peoples to Rondônia and the opening of BR-364 enabled the state to develop agriculture, livestock, and industry.

Agriculture was considered the main impetus for the Brazilian migrants, most of whom were farmers. Therefore, agriculture in Rondônia has always been conspicuous; the main agricultural products of the state are rice, corn, beans, cassava, bananas, cocoa, coffee and soy (CUNHA; MOSER, 2010).

In Rondônia, most of the temporary crops such as rice, beans, and corn are produced by family farmers. Its permanent crops such as coffee and cocoa are very important in the regional economy, since most farmers are coffee producers; for many they are the primary or exclusive source of income (COSTA, 2009).

According to the State Secretariat of Agriculture of the State of Rondônia – SEAGRI (2018) – of the 120,000 rural establishments in Rondônia with areas of up to 100 hectares, 85% are family-based. Approximately 90,000 families are responsible for 70-hectare plots producing food that reaches the tables of the population of Rondônia.

IV. RURAL CREDIT

According to Law No. 4,829/65, rural credit is defined as the provision of financial resources by public entities and private credit establishments to agricultural producers or their cooperatives aimed at stimulating the orderly growth of rural investments to meet the timely and adequate costs of producing and marketing of goods; strengthen the economic activity of agricultural producers; and encourage the introduction of rational production methods (BRASIL, 2019).

Rural credit falls into three types: costing credits, intended to cover the usual expenses of the cycles of production and the purchase of inputs at harvest time:investment credits, invested in durable goods or services, the benefits of which are reflected for many years; and commercialization credits, which guarantee the rural producer and his cooperatives enough resources to supply and store cropswhen pricesfall (MAPA, 2018).

4.1 CREDIT LINES FOR FAMILY AGRICULTURE

Until the beginning of the 1990s, there was no national public policy in Brazil that took account of the peculiarities of the family farmers' segment. The National Program for Strengthening Family Farming (PRONAF), institutionalized by Decree No. 1,946/1996, has become the preamble and the most important public policy in Brazil for family

https://dx.doi.org/10.22161/ijaers.69.23 *ISSN: 2349-6495(P) | 2456-1908(O)*

farmers (JUNQUEIRA; LIMA, 2008; SCHNEIDER; CASSOL, 2013; GRISA; SCHNEIDER, 2014).

PRONAF qualifies a rural producer to benefit from rural credit lines if he meets the following requirements: to be a landowner, tenant, lessee, partner or land reform concessionaire, residing on or near a property; holding, in any form, a minimum of four land tax modules or a maximum of six modules; obtaining 80% of his annual gross family income from exploiting agricultural or non-agricultural production and maintaining up to two permanent employees.

With help from others meeting these requirements, a family farmer can issue the PRONAF-DAP Declaration of Aptitude (EDUCATOR'S MANUAL, 2014).

As the leading supporter of family farming, PRONAF has since 2003 aimed to promote sustainable development, where family farmers can access various lines of credit according to their needs, thus seeking to meet the individual credit demands from all those engaged in family farming. Several financing lines have been created. The main differences between them lie in their low-interest rates, periods to maturity and default bonds. PRONAF's main credit lines extend to Costing, Investment, Agro-Industry, Agroecology, Eco, Forest, Women, Youth, Quota, Rural Microcredit, and More Food (MORET, 2014; MDA, 2016).

In addition to PRONAF, farmers have other incentive programs for family producers, such as the Food Acquisition Program (PAA). This is a public policy instrument established by article 19 of Law no. 10,696/03, representing a milestone in the policies for the family agricultural sector. The PAA guarantees the purchase of family produce for school meals, kindergartens, hospitals, etc., enabling family farmers to feel more secure about selling their products and ensuring cash flow in the economy of their region. In guaranteeing the commercialization of production, the programme can be considered an extra PRONAF initiative (JUNQUEIRA; LIMA, 2008). A; LIMA, 2008).

The importance of the PAA is still connected not only with the timing of production but also with distribution, benefiting family farmers who cannot easily dispose of their harvest. The programme, in this sense, strengthens the domestic market, improving the diet of families and ensuring a demand for the food produced in family farming (JUNQUEIRA; LIMA, 2008).

4.2 ACCESS TO CREDIT

Access to credit is crucial for driving the growth of agriculture, which depends mainly on small farms. However, farmers sometimes find it hard to access information on ways to acquire credit, or even to know its impact on the rural environment, where the risks are perceived to be higher. This compounds the problem of granting credit to a significant portion of agricultural producers (ROCHA; SANTIAGO, 2013).

In order to lend money, financial institutions rely on the information presented by Law No. 4,829 of November 5, 1965, which states that credit operations have some essential requirements such as the suitability of the person applying for credit and presentation of the budget/project to be carried out, which will be monitored by the funder (ROCHA; SANTIAGO, 2013).

The rural credit financing institutions which are responsible for transferring credit to agricultural and agro-industrial producers are Banco do Brasil, the National Bank for Economic and Social Development (BNDES), credit unions and private banks (OLIVEIRA; ARAÚJO; QUEIROZ, 2017).

Even when they can access credit, life is not easy for farmers. They face such difficulties as their own vulnerability to financial institutions, the problem of obtaining the required documentation, the lack of certainty that they can repay a loan, etc. These features cause many family farmers to stop resorting to credit operations to finance their production, which makes it challenging to stay competitive (BELIK, 2017; OLIVEIRA; ARAÚJO; QUEIROZ, 2017).

V. PRICING OF PRODUCTS IN FAMILYAGRICULTURE

For the farmer to earn anything, he needs to market his produce at a price capable of meeting his need to cover input costs and satisfactorily repay him for his work. It can be said that commercialization is the first face of family farming activity; however, it is also one of the main obstacles to its development (BELIK, 2017).

One of the challenges faced is the oversupply of many products in the harvest season, where there are many suppliers. The price drops gradually, only to appreciate again in the inter-harvest period, causing farmers to sell their products cheaply, because they need resources to live and their products are often perishable (REDIN, 2013).

It is also noted that agricultural products are not always the marketed directly to the consumer because sales are made through someone who buys to resell and sets his own

https://dx.doi.org/10.22161/ijaers.69.23 *ISSN: 2349-6495(P) | 2456-1908(O)*

price, leaving producers susceptible to his demands. This situation means that a product is not always sold at a satisfactory rate, capable of covering the inputs and the labour involved in its production. Another negative factor for the commercialization of products is the lack of official confirmation for many prices in the local market (NASCIMENTO et al., 2016).

One point to consider is the way in which the price of rural products is set, involving cost accounting, because many small producers do not use any mechanism to aggregate the sale price to the product they grow. Family farming is an example; farmers do not record production costs and expenses, and thus have no basis for setting a price where they can see what profit or loss might be entailed (SILVA, 2017).

According to Silva (2017), too, accounting applied to a small, medium or large rural property has the advantage of recording the costs of preparing the soil, planting, fertilizing, harvesting, and processing, giving the producer subsidies related to its production, and generating information for decision making and control.

VI. METHODOLOGY

To carry out the research, and fulfil the proposed objectives, analysis was applied with a qualitative approach, guided by the deductive method, as described by Prodanov and Freitas (2013) and Lira (2014).

Data were collected from semi-structured on-site interviews asking open and closed questions, as recommended by Ruiz (2011). The research subjects were chosen by simple random sampling. Thirty active family farmers were interviewed from a total of sixty-five members of the Astra Association of Rural Producers of Line 09 in the municipality of Cacoal, Rondônia State.

The collected data were grouped according to their similarity, and were later analysed, interpreted and discussed on the basis of reference to the theme; the results are presented through graphic figures. Content analysis technique was used to analyse the data with the help of electronic tools, such as Word and Excel. These were able to show the results of this analysis clearly and precisely.

VII. PRESENTATION OF RESULTS

Initially, we wanted to learn about the profile of family farmers and asked about the data relevant to the research, such as gender, age, marital status, whether they had children, education level, income, etc. Thirty family farmers participated in the survey, of whom 96.7% were male and 3.3% female. While men predominated in the total, it will not be forgotten that their wives and children also helped in the process of production. As regards age groups, 36.7% were over 51 years old, 53.3% were between 31 and 50 years old and 10.0% of them were younger than 30.

These results, when compared to studies done in rural communities in southern Amazonas, such as those by Alves and Rocha (2010) and Gomes, Nogueira and Costa (2018), demonstrate the predominance of males in rural areas, where it was verified that 75.5% of the farmers are male, 24.5% female and 66% have an average age of above 40 years, 22.6% are between 30 and 40 years old and 11.3% between 18 and 30 years old. Data on age range indicate that younger farmers are in short supply, making it difficult for many of them to work and be productive.

This scenario demonstrates the urgency of developing policies for encouraging young people to return tothe countryside. These studies also show that smaller numbers of young people remain in rural areas; many have migrated to the city in search of employment.

Among the farmers, 93.3% stated that they were married, as reflected in the number of children, and only 6.7% declared themselves single. Roughly the same proportion is verified by Oliveira (2016) among family farmers in the municipality of Cacoal-RO: 88% were married and only 8% single. Regarding the number of children, 6.7% of the respondents had 4 (four) children, 10% had 3 (three) children, 50% had 2 (two),26.7% had 1 (one) child and 6.7% had no children. as regards the number of members per family, 13.3% of families had 5 or more members, 46.7% had four members, 23.3% had three members, and 16.7% had two members.

The data collected in the interview reveal that most rural farmers had not completed high school. When asked about this point, they argued that it had been tough for them to study when they were young people and work took priority, given their family's economic difficulties. These data are similar to what Oliveira found (2016):66% of family farmers reported having attended primary school, 17% reported having attended elementary school, 13% had completed high school and (2%) were illiterate.

Regarding income, it was found that 66.7% had a total monthly income of 1 to 2 minimum wages from family farming, 26.7% had from 2 to 3 minimum wages, 3.3% had a profit equalling 3 to 4 minimum wages and 3.3% enjoyed 4 to 5 minimum wages, as shown in the following Figures 1 and 2.These data confirm that the average income of the families approached by the survey was approximately two

https://dx.doi.org/10.22161/ijaers.69.23 ISSN: 2349-6495(P) | 2456-1908(O)

minimum wages. Regarding the number of people who depend on a family income, it was observed that 40% of the properties with 2 to 3 people did, 47% of the properties with 4 people and 13% of the properties with 5 or more depended on it. Regarding the financial condition of farmers, 66.7% of the respondents answered that the income from family farming was enough to keep a family in the countryside, while for 33.3% the pay was not enough.

The respondents claimed that they could afford only production and housing expenses. The low prices of rural commodities prevent them from earning a better income or even from having a financially quiet life.

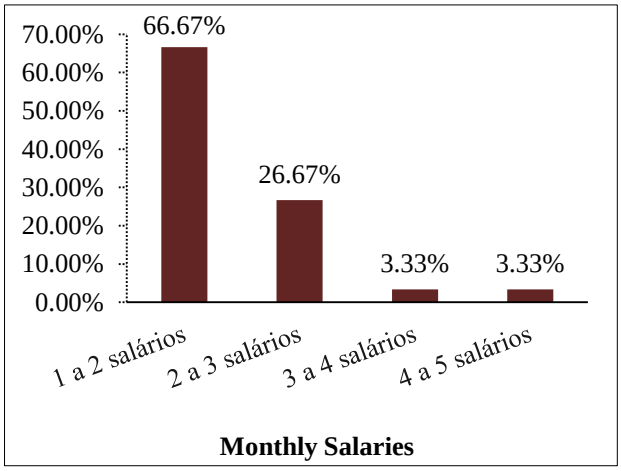

Fig.1: The income from family farming.
Source: Research data, (2019).

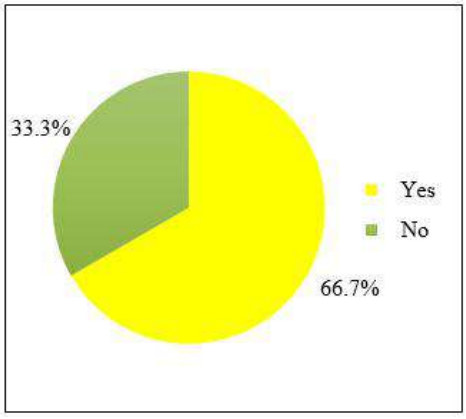

Fig.2: Monthly family income of producers.
Source: Research data, (2019).

Regarding the ownership of the land used by the farmers who took part in the survey, a characteristic that influences the acquisition of rural credit, it was found that 73.3% of the family farmers were owners, 20.0% were bound by loan agreements with the children of their owners and 6.7% were sharecroppers.

By analysing the data, one can also identify the main difficulties, such as access to credit, the pricing of products, production flow, and technical assistance. Among the survey participants, 56.7% were using or had already used rural credit through PRONAF, and of this percentage, about 35.3% usedthe investment type of credit at least once per year, 52, 9% usedthe investment modeat least twice a year and 11.8% used it once a year for costing operations.

In this sense, it is worth mentioning that Rocha and Santiago (2013) state that rural credit is of great importance for strengthening the economic transactions of small and medium-sized agricultural producers, stimulating their investments, leveraging income generation and influencing the improvement of their quality of life.

Thus, we sought to identify the reasons that had led the farmers in the survey to acquire rural credit. It was verified that the purposes of credit gave family farmers enough confidence to seek it, as follows: to invest in agriculture (58.8%), toinvest in livestock (29.4%) and to invest in other enterprises (11.8%). Farmers' opinions and their evaluation of the government's applied agricultural credit policies were also taken into account: 82.4% rated the credit policies as good because they metall their needs and 17.6% appreciated their regularity.

Although rural producers'think that the credit policies of rural credit are excellent, they claimed to have faced some difficulties in accessing it. The main challenges identified in acquiring an agricultural loan were the interest rates (5.9%) and the lack of accessibility (23.5%), while the remaining 70.6% had no problem in accessing credit, as can be seen in the Figures 3 and 4.

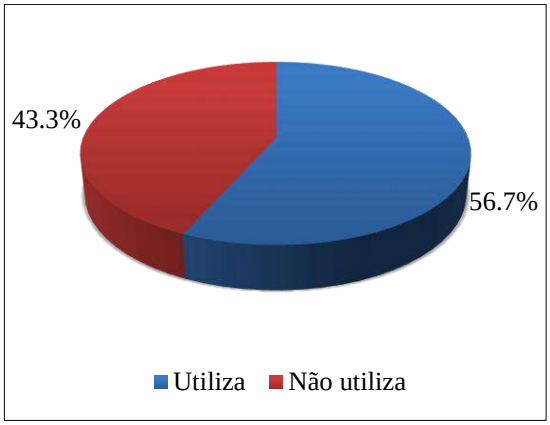

Fig.3: Rural credit.
Source: Research data (2019).

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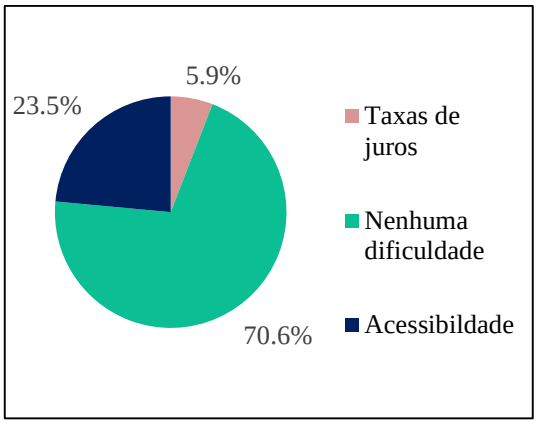

Fig.4: Difficulties- Rural Credit.
Source: Research data (2019).

According to respondent R 20 "Rural credit should be more accessible. Since not everyone has a certain understanding of the subject, it should be more detailed and less bureaucratic."

A study by Freitas (2014) of the municipality of Cacoal, RO points out that the lack of information is an aggravating factor, because the producer needs to know the programs and how to access them. An obvious example is PRONAF, a program that all smallholders should have access to because it is focused on enhancing the potential of family farming.

However, 43.3% of farmers do not use rural credit, because many have no interest in buying, think they do not need, or have a particular fear of using and not repaying a loan or even believe that they are no eligible for such credit because they have little land and no guarantee of payment. Some of them still try to acquire credit, but give up halfway through, because it is a bureaucratic process about which they know little and because of the frequent demands for documentary backup.

A similar situation was also found in a study in Cachoeira do Sul-RS where 51.4% of family farmers reported having accessed PRONAF at least once, and 48.5% reported never having accessed it all (VARGAS et al. 2017).

Another obstacle for family farming is the pricing of agricultural products. In the present study family farmers were asked if their products were traded at a satisfactory price capable of covering the input and labour used in their production. 90% replied that the price was insufficient, because the cost of living was very high and inputs such as fertilizer to improve production were needed every day but were expensive.

According to respondent R24 "This situation is dismal for the farmer, because it increases the price of everything, such as energy, gasoline, inputs to production, etc. while the prices of rural products only fall".

When asked how the sales price of a product is defined, 14 (fourteen) farmers, corresponding to 46.6% of the total, answered that it depended on the number of competitors and the demand for the product. More than half the respondents, 53.4%, said that they did not have a system for calculating prices and it was found that farmers had no control or accounting records, not even in note form.

A study of family farmers in the city of Captain Poço, in the state of Pará, conducted by Silva (2017), found similar results. It demonstrated that farmers often do not write down their costs, expenses, or profit, showing a complete lack of control over the value of what they produce. They consequently fail to price products systematically and therefore cannot correctly account for profit or loss.

Silva (2017) states that farmers' fear is still one of the major impediments to the use of accounting in rural affairs, causing losses to production and a failure to benefit from accounting tools for better management and control.

Finally, the research participants were asked what could increase their productivity. The most representative items were: a) Financial resources for family farming; b) Government support and encouragement in agriculture; c) Appreciation of the countryman; d) Price guarantees for rural products; e) Assistance from a government agency focused on agriculture; f) More agricultural equipment; g) Technical assistance on the property; h) Improvement of rural roads, among other things. This makes it clear that family farming has many problems and is an altogether challenging way of life.

VIII. CONCLUSION

Through the research, it was identified that most of the producers approached were male and had had too little education. It has also been identified that Cacoal family farmers face a number of difficulties.

Regarding access to rural credit 23.5% of farmers in the survey said that the main difficulty related to agricultural credit was the accessibility of credit. This damages the sector, for confidence is essential if investment is to stimulate production. However, a decisive factor is that 70.6% had no difficulty in acquiring credit, so it was not an obstacle for many more than half of the family farmers under study.

https://dx.doi.org/10.22161/ijaers.69.23 *ISSN: 2349-6495(P) | 2456-1908(O)*

About the pricing of products, 50% face difficulties from the middlemen, who set low prices, which consequently do not generate enough revenue to cover their expenses.

It can also be seen that family farming is of great importance to the economy of the municipality, state and country. However, according to the survey, the family farmers interviewed do not receive sufficient support and encouragement to make progress; their need for more attention from the public sector is becoming a negative factor for family farming. It is also noted that rural mendo not properly appreciate their own products; but it is through these farmers that the food reaches the family table.

It may be concluded that many leave, without trying to improve production due to the poor better working conditions, lack of structure, and lack of hope for the future, consequently undermining production capacity. Another factor is that the areas that are neglected are not designed to best advantage; since they are not mandatory for a farmer, but how are rural workers to get more prosperous farmhouses and the technical assistance they need for their property.

From the results presented in this research, it can be stated that the research aims were attained. In general the study contributed by providing more information about rural areas, where the work done is fundamental to local economic development and growth.

Future researchers are recommended to examine the difficulties faced by family farmers in another location, mapping their costs and expenses. According to this study, the biggest challenge is pricing; therefore, listing the actual costs and the producer's profit margin would be of great value to the people being studied, since the family farmers who responded to our questions had no record or control of their expenses.

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https://dx.doi.org/10.22161/ijaers.69.24 *ISSN: 2349-6495(P) | 2456-1908(O)*

Characterization of Publications that Discuss the Bauman's Theory of Liquidity and its Relationship with Management Aspects

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Abstract— *This study aims at characterizing the publications that discuss the Bauman's theory of liquidity and investigating its relationship with management aspects. To this end, a systematic review was used with meta-analysis involving a type of exploratory research and a mixed data analysis approach, i.e., qualitative and quantitative. The PSPP, Ucinet® and Nvivo® softwares were used as support. Data collection was through the bibliographic review of articles, dissertations and theses selected in the Web of Science, SCOPUS and CAPES Thesis and Dissertations Database. The results show that most of the studies researched used Bauman's theory of liquidity as a background to contextualize the phenomenon studied and are, also in their majority, theoretical. The empirical studies found do not corroborate the theory of liquidity and are also unrelated to management.*
Keywords*— *Theory of liquidity. Bauman. Empiricism. Meta-analysis. Management.

I. INTRODUCTION

Bauman's theory of liquidity has been widely discussed in the academic world in the most diverse fields of professional training. This theory, which began to be discussed from the end of the 1990s, deals with the fluidity and lightness of the actions, attitudes, behaviors and decisions of individuals living in a society that is considered liquid. Contrary to what is solid, which has clear spatial dimensions, liquids undergo constant shape change when they are subjected to any tension.

This is because the changes that occur nowadays are highly rapid, as pointed out (Leal, 2002) when stating that this era is marked by the confusion of concepts, and that relativism is a striking feature, thus, with the loss or abandonment of theoretical references there is little possibility of deepening the reflection on the problems and by implication, generate equally rapid consequences and responsibilities. In the same way, these actions, attitudes and behavior are replaced by others with the same or faster frequency. And, an important point is that it is not a matter of mere ephemerality, but of a set of values that leads 'humanity' to paths that are often unknown, and with obscure destinies.

To melt the solid, according to Bauman (2001), implies in changing the stagnant and too resistant society to mold the new wills and ambitions of the individual, since the 'communist Manifesto,' about 150 years ago. In this period, melting the solid meant the "[...] repudiation and dethronement of the past [...] the crushing of the forged armor of beliefs and loyalties that allowed the solids to resist 'liquefaction'." (Bauman, 2001, p. 10). However, the melted solid was remade and re-molded into another form, but now into a liquid configuration that under pressure adapts and changes form again. As Bauman (2001, p. 14) writes, "[...] people were freed from their old cages only to be admonished and censored if they could not reallocate themselves, through their own dedicated, continuous and truly endless efforts [...]." The author further indicates that "[...] the task of free individuals was to use their new freedom to find the appropriate niche and there to settle and adapt: faithfully following the rules and modes of conduct identified as appropriate [...]." Thus, one realizes that the liquid obtained from the solid is shaped in order to solidify again, that is, it causes individuals to have to adapt to new beliefs and loyalties, and thus, new cages.

Another crucial point in modern society is that time is more important than space. In solidity, the territorial space was synonymous with power, in liquidity, the headquarters space the importance for time. As Bauman (2001) points out, the contemporary global elite is formed by 'absent lords.' This implies that they can dominate economic, social and technological aspects without taking care of business administration, the well-being of employees or even the socioeconomic development of the place. Thus, liquid modernity implies that power is also fluid, mobile and increasingly slippery.

Bauman (2001) points out that the advent of liquid modernity has produced profound changes in the human

https://dx.doi.org/10.22161/ijaers.69.24 ISSN: 2349-6495(P) | 2456-1908(O)

condition in aspects such as emancipation, individuality, time and space, work and community. Thus, the liquid society increasingly instigates that individuals seek freedom. Freedom to be, to have, to act beyond others the other possibilities of nuances that freedom can have. However, in order there is freedom, the emancipation of man is necessary.

To emancipate, you have to free yourself from society. However, Bauman is based on Marcuse in raising a problem faced for emancipation, which is that "[...] few people wanted to be liberated, even less were willing to act for it, and virtually nobody was sure how the 'liberation of society' could be distinguished from the state in which it was found" (Bauman, 2001, p. 26).

This concern refers to Plato (2012) when discussing what became known as the myth of the cave: people who lived in a cave, trapped with their faces facing the bottom only knew the world through shadows that were projected into this cave. When freed, they would feel afraid to leave and see the world 'just like it is.'

Therefore, as Marcuse (1967, s. p.) points out, "We are dealing with the dialectics of liberation (in fact, a redundant phrase, because I believe that all dialectics is liberation) and not only liberation in the intellectual sense, but liberation involving the mind and the body, liberation that involves all human existence." The author continues with the following question: In what sense, which aspect treats dialectical liberation? Would it be the liberation of an organic system (regardless of being a social, mental or intellectual system), which is repressive, false or bad? Understanding this is a decisive point in search for freedom.

Marcuse (1967) also indicates that today, in fact since 1967, there is a different historical context for freedom, since, in general, one no longer lives in an oppressive society, but on the contrary, one lives in a relatively functional, rich and powerful society, that is, one seeks the liberation of an affluent society. This implies that the problem facing us now is the need for liberation, not from a poor, disintegrating society, nor from a terrorist society in most cases, but from a society that, in a generalized way, supplies the material and cultural needs of man. In this way, individuals are facing the liberation of a society where liberation is apparently without a mass base. Marcuse's reflections lead us to understand that freedom today is not free, that is, freedom is imposed, but, if the individual is free, what will he/she do with that freedom?

But, in order to answer this question, it is necessary to clarify, what is freedom? To be or to feel free, according to Bauman (2001, p. 26) is, "[...] not to experience difficulty, obstacle, resistance or any other impediment to the intended or conceivable movements." The author also points out that "in the land of individual freedom to choose, the option of escaping individualization and refusing to participate in the game of individualization is decidedly out of play" (2001, p. 47). And he adds that "[...] both in the light and fluid stage of modernity and in the solid and heavy, individualization is a fatality and not a choice" (2001, p. 47).

Individualization, although it has always existed, in liquid modernity is more eloquent. As Bauman (2001) points out, it (individualization) elevates the ever-increasing number of people to an unprecedented freedom, but it also brings the unprecedented task of facing the consequences.

Another relevant point when it comes to individualization is that there are two types of individuals: *Dejure* and *De facto*. *Dejure* individual is born from compulsive self-criticism, that is, he/she is the one who has no one to blame for his/her own misery, that is, who does not seek out (from himself/herself) the reasons for his/her own defeat but in his/her own laziness and there is no other solution but to continue trying with greater determination. Coexisting with the risk of self-reproach on a daily basis is no easy task. And the consequence of this is to focus on one's own performance, which leads to divert attention from the social space where the contradictions of the individual's existence are collectively produced, thus forgetting about political life. *Defacto* individual, on the other hand, is the one who controls the resources indispensable to genuine self-determination, that is, the one who takes control over his/her destiny and makes decisions that he/she truly desires (Bauman, 2001).

In this sense, the great question that Bauman points out in this reflection is that the evolution of the individual cannot exist without this look at the social space, at political life. "The *jure* individual cannot become a *Defacto* individual without first becoming a citizen. There are no autonomous individuals without an autonomous society, and the autonomy of society requires a deliberate and perpetual self-constitution, something that can only be a shared achievement of its members" (Bauman, 2001, p. 55).

Freedom and autonomy are intimately linked to thought, and refers once again to Plato, when he pointed out that perhaps there was no communication between those who "left the cave" and those who "stayed in the cave," since those who stayed would not listen to those who left.

About this, Adorno (1951, p. 14) points out that "[...] no thought is immune to its communication, and it is enough to express it in a false place and in a false agreement to undermine its truth." Complementing on the importance of thought and communication Kant (1783, p. 1) points out that:

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Enlightenment is the departure of the human being from its self-incurred minority, of which he himself is guilty. Minority is the inability to make use of one's understanding without the direction of another individual. The human being is guilty of this minority himself if the cause is not the lack of understanding, but the lack of decision and courage to use himself without the direction of another. *Sapereaude*! Have the courage to make use of your own understanding, this is the motto of enlightenment.

Adding, Adorno (1951, p. 35) indicates that "The problem, almost insoluble, consists here in not allowing oneself to get imbecile either by the power of others or by one's own impotence."

Thus, it is clear that knowledge is an essential element for the individual's autonomy, i.e., to be able to manage himself/herself by taking his/her own decisions. Another important point about knowledge is pointed out by Adorno and Horkheimer (1969, p. 5), who state that "power and knowledge are synonyms." And that "Between knowledge and power there exists not only a relationship of servility, but also of truth. Much knowledge, although formally true, is null outside of all proportion with the distribution of powers" (Adorno, 1951, p. 34).

Still, on knowledge and power, Bauman (2001) points out that the union between these two elements that was only imaginative in Plato's time, became a premise of philosophy and a commonly repeated statement of politics. However, the author also highlights that emancipating and liberating ambitions face an obstacle: how to limit the corrupting impact of power and domination to those who are indifferent or resistant to change?

Anyway, as Bauman (2001) says, it is in this liquid society that we find the opportunities and threats of individual autonomy, autonomy that cannot exist except in an autonomous society, that which does not let knowledge be corrupted by power.

Thus, in this context, one has as research question: Which areas and themes corroborate Bauman's theory of liquidity, and what is its relationship with management aspects? Therefore, the objective of this study is to characterize the publications that discuss Bauman's theory of liquidity, and as specific objectives, to list which areas corroborate Bauman's theory and to investigate its relationship with management aspects.

II. MATERIALS AND METHODS

The systematic review implies a series of actions to achieve the proposed objective, thus, the type of exploratory research will be used, and, according to Lakatos and Marconi (2010), it is the one that allows the researcher to have greater contact with the phenomenon studied. As for the data analysis, this will happen through the mixed nature. The research of quantitative nature, according to Fachin (2006), is the one where the data are quantified and measured. As for the qualitative approach, Richardson et al. (2008) cite that this differs from the quantitative since it does not use statistical instruments in its analysis. Thus, some data are not proven with numbers.

According to (Sampaio & Mancini, 2007) the systematic review is a verification that investigates secondary data in search of evidence on a given theme. These are useful to integrate the information from a grouping of studies conducted separately on a given theme, which may present contradictory or coincident results, as well as identify themes that require evidence, helping in the direction of future research. The steps of the systematic review are presented in the sequence.

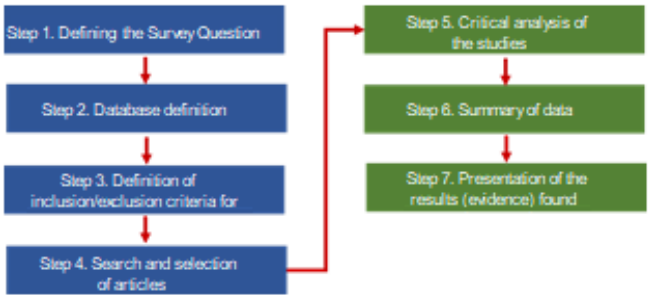

Fig.1: Steps of the systematic review

Source: Adapted from Sampaio and Mancini (2007)

Publications on Bauman's Theory of Liquidity available in the Web of Science and SCOPUS databases were analyzed, as well as the CAPES Thesis Catalogue to identify if the theory is being discussed within the Stricto Sensu programs. The research clipping is cross-sectional, and the collection took place on March 4 in the CAPES Thesis Catalogue and March 23, 2019 in the index bases.

The inclusion/exclusion parameters for the selection of articles were as follows: with the descriptors we used Liquidity; liquid*; Bauman, without period limitation, and without restriction of type of document. The Web of Science resulted in 17 documents, 13 of which were published, 3 articles in process, and 1 editorial material. The search in the SCOPUS database resulted in 152 documents that were articles and interviews, totaling 169 documents in both databases. The inclusion/description criteria were expanded with the items, language, type of document and accessibility (the article being free or paid for), in addition to the main one, dealing with Bauman's theory of liquidity. Although Qualis recognizes and classifies the best researches in Brazil, as indicated by Soeiro and Wanderley (2019), only journals of graduate

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programs are classified, and as the purpose of this research was to identify the use/discussion of a theory, it was chosen not to put it in the parameters and inclusion/exclusion.

The survey in the Capes Catalogue of Theses had as inclusion/exclusion criteria the area of Applied Social Sciences, discuss Bauman's theory of liquidity and be between the period 2016 and 2019, in addition to access to the full work. Figure 2 shows the process adopted.

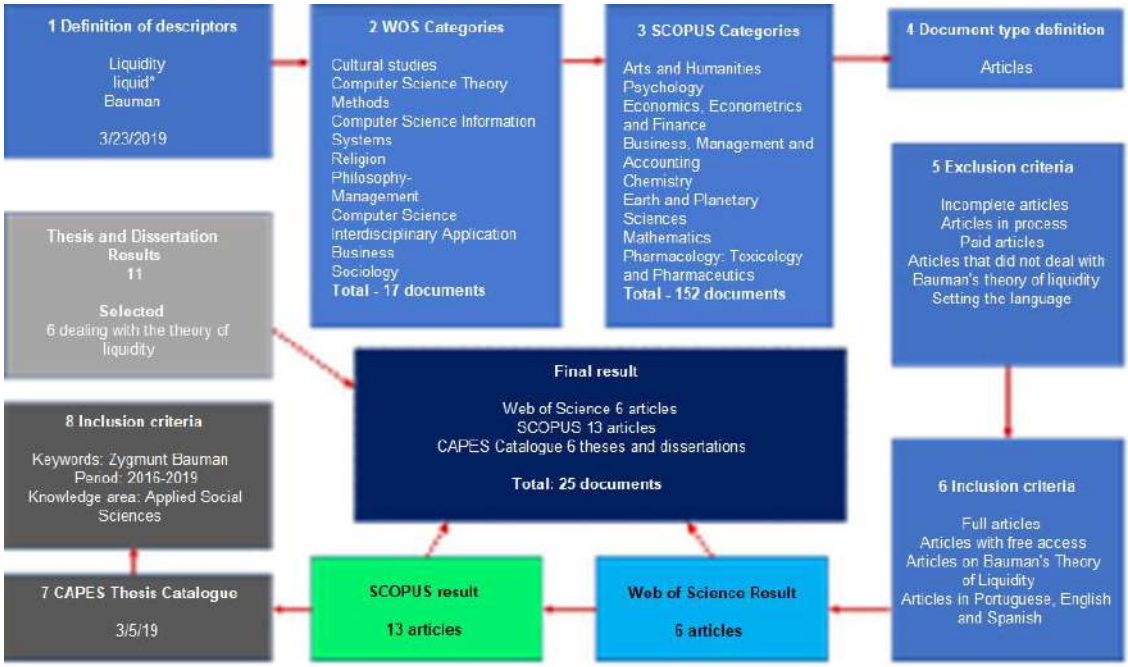

Fig.2: Inclusion and exclusion criteria for the selection of materials
Source: Prepared by the authors, 2019.

As it can be seen, a total of 25 documents were selected, 19 were full articles, with free access in Portuguese, English and Spanish, and 6 theses and dissertations from the Applied Social Sciences area that addressed Bauman's theory of liquidity in their programs. Among the documents excluded from the SCOPUS and Web of Science databases there are articles in Romanian and Croatian, abstract, critical essay on the theory, discussion on Bauman, biographical interview, presentation of the itinerary and reception of Bauman in France, paid articles, editorial material and duplicate articles.

In the analysis approach will be carried out the meta-analysis that according to Rodrigues and Ziegelmann (2010, p. 436), "[...] it is an appropriate statistical technique to combine results from different studies producing, thus, estimates that summarize the whole, called metanalytic estimates." Corroborating, Sampaio and Mancini (2007) point out that systematic reviews with meta-analysis is the most current and appropriate method to synthesize evidence on a given theme.

For this purpose, the software PSPP, UCINET® and NVIVO® were used as data analysis tools. The PSPP is a free software of analysis for statistical analysis.

III. RESULTS AND DISCUSSION

The 19 articles and 6 theses and dissertations are presented below. These will be analyzed in order to answer the research question: Which areas and themes corroborate Bauman's theory of liquidity, and what is its relationship with management aspects?

As it can be seen in Chart 1, the articles selected for this research are distributed in several journals, most of them international. It is also possible to observe the selected theses and dissertations were developed in 4 universities with programs with scores between 4 and 5 in the MEC´s evaluation.

Chart 1:Data from the selected documents

N	AUTHORS	TITLE	JOURNAL	COUNTRY
		WEB OF SCIENCE		
1	(Lee, 2011)	**Modernity, solidity and agency**: liquidity reconsidered	Sociology -The Journal of the British Sociological Association	Malaysia
2	(Kociatkiewicz & Kostera, 2018)	**After Retrotopia?** The future of organizing and the thought of Zygmunt Bauman	Scandinavian Journal of	United Kingdom and

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	Management		Poland
3	(Ali, 2013)	**Secularism**: from solidity to liquidity	
	Cultura - International Journal of Philosophy of Culture and Axiology		Germany
4	(S. Costa, 2016)	**Liturgiaem "tempos líquidos"**	
	Revista de CulturaTeológica		Brazil
5	(Jay, 2010)	**Liquidity crisis**: Zygmunt Bauman and the incredible lightness of modernity	
	Theory Culture & Society		USA
6	(Perkiss & Handley, 2017)	**Making sense of contemporary disast ers**: a liquid development perspective	
	International Journal of Sociology and Social Policy		United Kingdom
	SCOPUS		
7	(Joubert, 2018)	**"Flowing" under the radar in a multifaceted liquid reality**: the ekerk narrative	
	HTS Teologiese Studies		South Africa
8	(Sigahi & Saltorato, 2018)	**A emergência da universidade operacional**: redes, liquidez e capitalismo acadêmico	
	Educação e Sociedade		Brazil
9	(Chávez, 2018)	**Informaciónlíquidaen la era de la posverdad**	
	Revista General de Informacion y Documentacion		Spain
10	(DeLuca, Ligia, Grisci, Domingas, & Lazzarotto, 2018)	**Trabalhar e tatuar-se**: estratégia de inventar a vida	
	Psicologia e Sociedade		Brazil
11	(López, 2017)	**De refugiados a parias, en la modernidadlíquida**	
	Revista Mexicana de CienciasPolíticas y Sociales		Mexico
12	(Gevehr, 2016)	**A crise dos lugares de memória e dos espaçosidentitários no contexto da modernidade**: questões para o ensino de história	
	RevistaBrasileira de Educação		Brazil
13	(R. B. Silva, Mendes, & Alves, 2015)	**O conceito de líquidoem Zygmunt Bauman**: contemporaneidade e produção de subjetividade	
	Athenea Digital		Spain
14	(V. S. Costa, 2015)	**"Tempos líquidos":**desafio para a nova evangelização	
	Theologica Xaveriana		Colombia
15	(Shahghasemi , Masoumi, Akhavan, & Tafazzoli, 2015)	**Liquid love in Iran**: a mixed method approach	
	Mediterranean Journal of Social Sciences		Italy
16	(Rossoni, 2015)	**Residêncianaatençãobásica à saúdeem tempos líquidos**	
	Physis: Revista de SaúdeColetiva		Brazil
17	(Grisci, Bitencourt, & Fleck, 2012)	**Trabalhoimaterial, medo, solidão**: "amigos de aluguel" nasociedadelíquido-moderna	
	PsicologiaemEstudo		Brazil
18	(Moreira & Pessoa, 2012)	**De lo solido a lo liquido**: las nuevasalfabetizaciones ante los cambiosculturales de la WEB 2.0	
	Comunicar		Spain
19	(Redmond, 2010)	**Avatar Obama in the age of liquid celebrity**	
	Celebrity Studies		United Kingdom
	CATÁLOGO DE TESES DA CAPES		
	AUTOR	**TÍTULO**	**PROGRAMA**
1	(Pinho, 2018)	**Ódiolíquido**: Confrontos entre o bem e o mal namídiaparaense	Comunicação, Cultura e Amazônia
T	Dissertação	**IES**	UFPA
Keywords	Amazônia Paraense; Direitos Humanos; ÓdioLíquido; Midiatização; Grupo RBA.		
2	(Olbermann, 2017)	**Captura à vida de alto executivo**: dispositivosemcenascotidianas	Administration
T	Dissertation	**IES**	UFRGS
Keywords	Vida Líquida; TrabalhoImaterial; Dispositivo; Alto Executivo.		
3	(Deus, 2017)	**Embelezamentofísico**: requisito da gestão gerencialista para o exercício do trabalhoimaterial	Administration
T	Thesis	**IES**	UFRGS
Keywords	EmbelezamentoFísico; Gestão Gerencialista; TrabalhoImaterial; CirurgiaPlásticaEstética.		
4	(R. C. Silva, 2017)	**Corpo e contemporaneidade**: umaabordagemcríticaso breospadrões de beleza e consumoestético da mulherveiculadospelas mídias	Social Communication
T	Dissertation	**IES**	UMESP
Keywords	Corpo;Mídia;Consumo;Mulher;Comunicação;Cultura;Contemporaneidade.		
5	(B. A. Silva, 2017)	**Reencantamento via consumo**: Intersecções entre religião e consumonas redes sociaisdigitais	Communication
T	Dissertation	**IES**	UFPE
Keywords	Consumo;Discurso; Redes sociaisdigitais; Reencantamento do mundo;Religião.		
6	(Arruda, 2018)	**Contemplação assíncrona**: a estratégia	Administration

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		de viver a vida pós-pedido de demissão de trabalhadores do setor bancário	
T	Dissertação	**IES**	UFRGS
Keywords	Sociedadelíquido-moderna; Estratégia de Viver a Vida; Pedido de demissão; SetorBancário.		

Source: Prepared by the authors, 2019.

As shown, 5 dissertations and 1 thesis from the Federal University of Pará, Federal University of Rio Grande do Sul (2 dissertations and 1 thesis), Federal University of Pernambuco and Methodist University of São Paulo were selected. The programs that studied Bauman's theory of liquidity were Administration and Communication, 3 works each.

Although the dissertations and thesis address the theory of liquidity, the keywords do not present much relationship among the works, as it can be seen in chart 2.

Chart2:Keywords

1ª Dissertation
Amazôniaparaense, Direitoshumanos,**Ódiolíquido**, Midiatização, Grupo RBA
2ª Dissertation
Vida líquida, Trabalhoimaterial, Dispositivo, Alto executivo
3ª Thesis
Embelezamentofísico, Gestão gerencialista, **Trabalhoimaterial,** Cirurgiaplásticaestética
4ª Dissertation
Corpo, Mídia, Consumo, Mulher, Comunicação, Cultura
5ª Dissertation
Sociedadelíquido-moderna, Estratégia de viver a vida, Pedido de demissão, Setorbancário
6ª Dissertation
Consumo, Discurso, Redes sociaisdigitais, Reencantamento do mundo, Religião

Source: Prepared by the authors, 2019.

The works that show in their keywords terms that refer to the Theory of Liquidity are dissertation 1 with the term '*Ódiolíquido*,' dissertation 2 with the terms '*Vida líquida*' and '*Trabalho immaterial*,' thesis '3' also with the term '*Trabalhoimaterial*' and dissertation 5 with the term '*Sociedadelíquido-moderna*.' It is worth noting that thesis '3' and dissertation '4' deal with a similar subject '*CORPO*.' In the thesis, the physical beautification is a requirement or prerequisite for the women who develop the management activity, and the dissertation that treats the body and contemporaneity regarding the standards of beauty and aesthetic consumption of women conveyed by the media.

As for the articles, out of 19 selected, 8 are written by Brazilians. The number of authors per article varied from 1 to 4, and the nationalities per article varied from authors of the same nationality and mixed nationalities. The following figure shows the countries to which the authors belong.

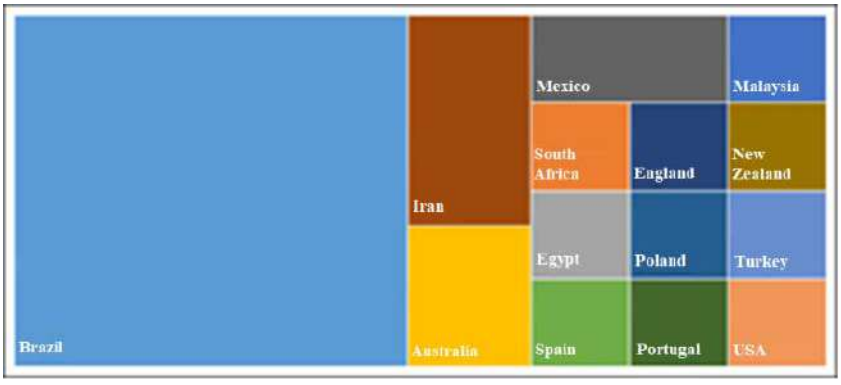

Fig.3: Countries

Source: Prepared by the authors, 2019.

As pointed out, most of the authors are Brazilian, corresponding to 48.48% of the total of 33 authors in 19 articles from 14 different countries. In the sequence, the Iranians with 9.09% participation, Australia and Mexico with 6.06% each, other countries had only one author in the selected delimitation.

The articles were analyzed for CAPES classification and SRJ Impact. According to CAPES (Coordination for the Improvement of Higher Education Personnel, 2014), the Qualis-journals is a system used to classify the scientific production of graduate programs regarding articles published in scientific journals.The process is based on the information obtained through the Data Collection app, and the results are made available through a list with the classification of the vehicles used by the graduate programs. Still, according to CAPES (2014, s. p.), this

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classification is made "[...] by the **committees of consultants of each evaluation area following criteria previously defined by the area and approved by CTC-ES**, which seek to reflect the relative importance of different journals for a given area" (emphasis of the author).The text also points out that the 'Qualification' has the function of evaluating, only, the scientific production of graduate programs, i.e., any other journal outside the graduate programs is not considered by CAPES. This evaluation is updated annually, and the vehicles are framed in strata indicative of quality where, A1 is the highest; A2; B1; B2; B3; B4; B5; and C with lower level.

Another way of qualification in scientific journals is the SRJ (SCImago Journal Rank). This is a "[...] bibliometric indicator that measures the influence of a given journal by the average number of citations received in the last 3 years preceding the year under analysis and that are weighted depending on the area of knowledge and the prestige of the journal" (BCIJO, 2018, s. p.). Also, according to the author, this indicator shows the visibility of the journals contained in the SCOPUS database since 1996, and it is dedicated to the analysis, representation and retrieval of information by means of visualization techniques, thus, the SJR indicator provides an ordered list of scientific journals according to the citations received. Another important information is that it is possible to search for the SJR indicator, only journals that publish in open access, and that are indexed in Scielo or in the Web of Science. This analysis and formation of indicators are attributed by SCImago, it is formed by the research group of the Superior Council for Scientific Research (CSIC) which has as components the universities of Granada, Extremadura, Carlos III and Alcalá de Henares. In addition, the web platform has 34,100 journal titles from more than 5,000 international publishers. It also has metrics from 239 countries. (BCIJO, 2018). The results are shown below.

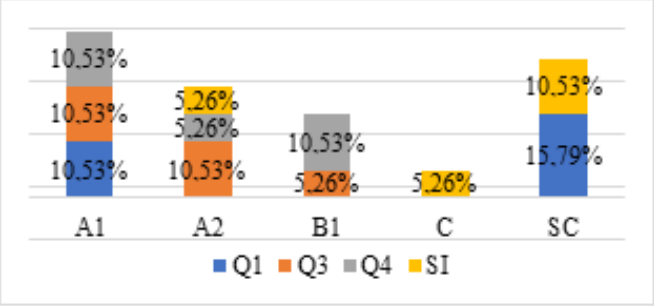

Fig.4: Qualifications of journals
Source: Prepared by the authors, 2019.

Although 31% of the journals analyzed are A1, only 10.53% are in Quartile 1, which is the best quartile, the rest in Quartiles 3 and 4, since none of the selected papers were classified as Impact SRJ Q2. Still, 21% of the selected journals are classified as A2, and from these, none belong to Quartile 1. As it can be seen, 10.53% belong to Quartile 3, 5.26% to Quartile 4, and 5.26% are not classified by the SJR system. In addition, 26.32% of the selected articles are not 'Qualified' and 21.05% have no impact factor.

The qualifications by database are shown below.

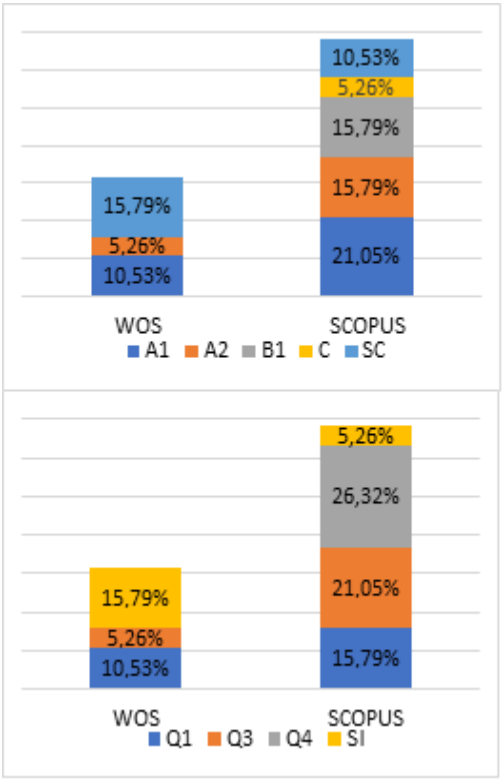

Fig.5: Qualifications per database

Source: Prepared by the authors, 2019.

It is possible to see that there is no significant difference between the databases and the SRJ classifications and indicators, since both indexers have journals that are not 'Qualified' or have no impact factor. It is worth mentioning that these are in significant quantity and 26.32% have no Qualis and 21.05% have no JRS indicator. The correlation between periods with Qualis and with the JRS Indicator is weak, showing a correction coefficient of 0.2354.

The journals were also analyzed according to the language that was published, combined with the language and the database Qualis.

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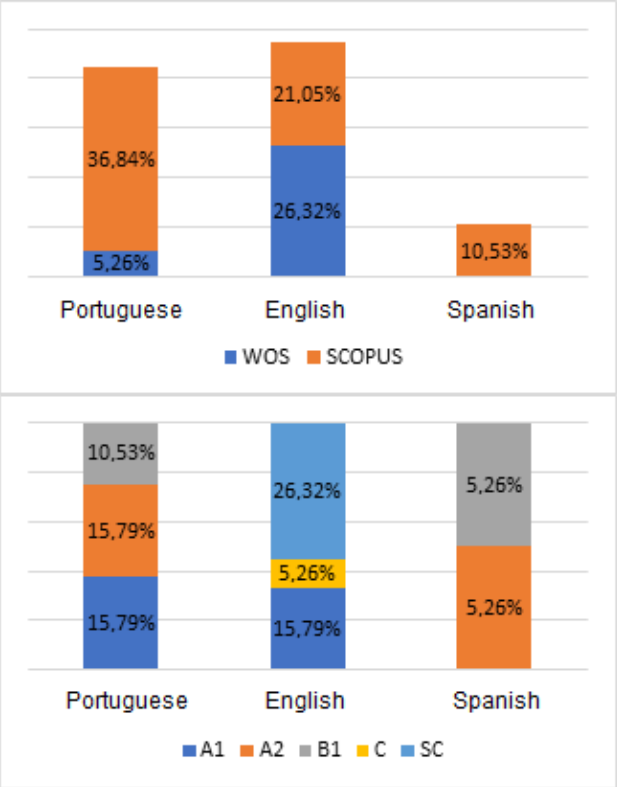

Fig.6: Database language and Qualis
Source: Prepared by the authors, 2019.

Most of the publications are in English, followed by Portuguese (42.11%) and to a lesser extent in Spanish. There is a weak correlation (0.3266) between the language and the Qualis of the index base, just as there is a weak correlation between JRS and the language (0.3340), although there is a considerable number of journals without Qualis (26.32%) and/or without JRS Indicator (21.05%), as already commented.

As for the years of publication, these do not change much over time. The following figure shows the years of the publications of the articles that comprise the analysis of this study.

Despite the higher number of publications in 2015, 2016 and 2018, there was a significant drop in the number of publications in 2017. There is no relationship between the year of publication and the Qualis of the journal, as well as the year of publication and the non-Qualification or impact factor of the journal. These two variables have as correlation coefficient - 0.1167, which implies a very weak correlation. Also, it is noted that there is no relationship between the year of publication and the JRS factor, despite presenting a moderate correlation coefficient of 0.4559.

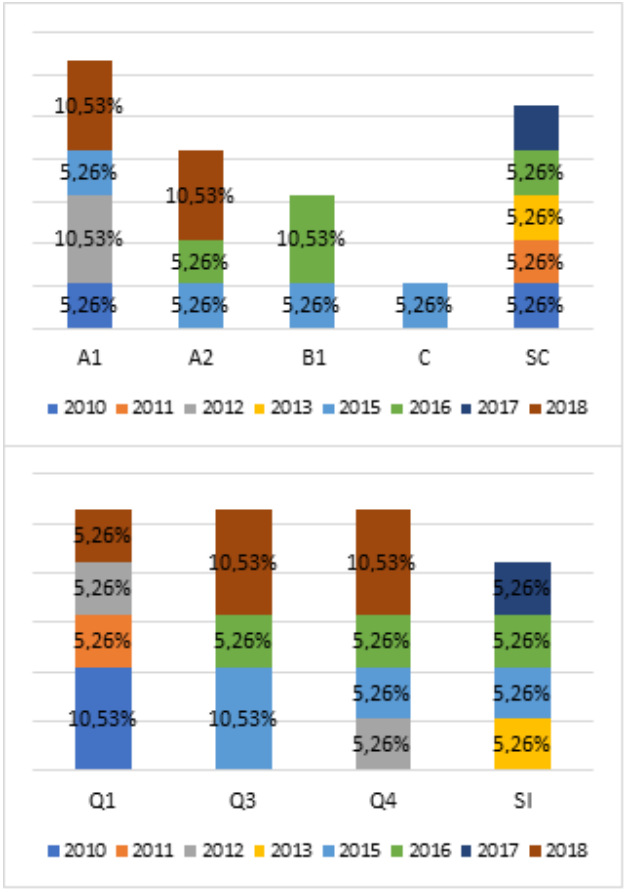

Fig.7: Years of publications and classifications
Source: Prepared by the authors, 2019.

As for the areas that used Bauman's theory of liquidity in their discussions, these vary greatly, totaling 10 different areas. In the following, all the areas are shown.

The area that most used Bauman's Theory of Liquidity was Education, corresponding to 21.05% of the publications, followed by Religion with 15.79%, Communication, Economics and Business, Psychology and Philosophy representing 10.53% each of the total. The other areas have only one publication.

An interesting issue arises when analyzing the relationship between area and language. In Portuguese, the most published area was Education with 37.5% of the total number of articles in Portuguese, which represents 15.79% of the total number of articles. In English, the most published area was Economics and Business with 10.73% of the total number of articles published in English, and in Spanish, the areas they published were Communication and Philosophy, representing 5.26% each of the total number of articles. The correlation coefficient was - 0.4514, which indicates a moderate negative correlation between language and area of study. As it can be seen in the figure below.

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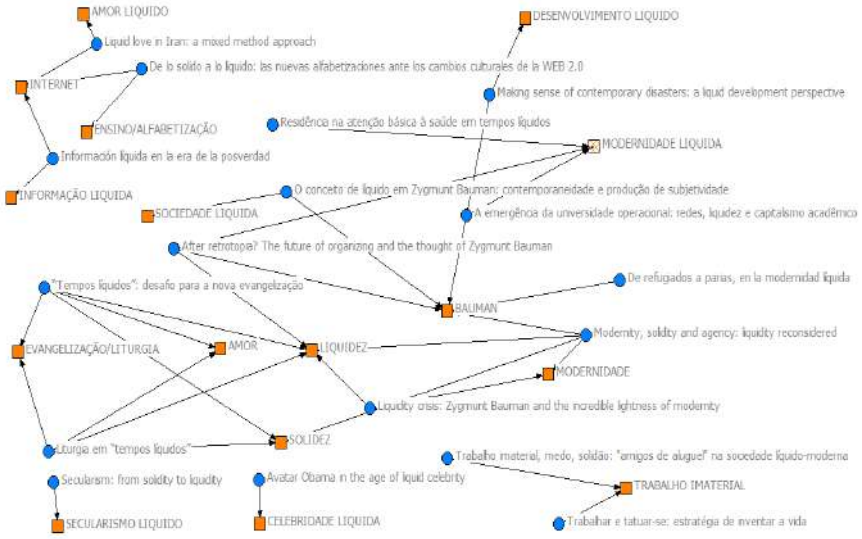

Fig.8: Areas that discussed Bauman's Liquidity
Source: Prepared by the authors, 2019

Complementing afterwards with the use of UCINET® by Borgatti, Everett and Freeman (2002), the relationship between the titles and areas studied in the articles is shown.

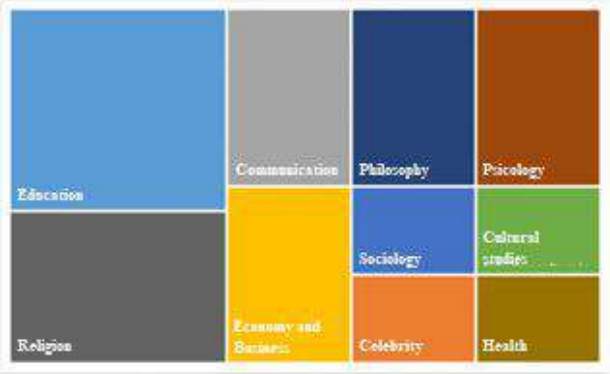

Figure 9: Relationship title and area of study
Source: Prepared by the authors, 2019

The titles address very diverse themes ranging from basic health care to celebrities. And although only two articles have been categorized as Economics and Business, the texts in the areas of communication and psychology also deal with issues that are addressed by administration.

The correlation between the area of study and the classification of journals was also analyzed. The correlation between the area and the Qualis is weak, showing a negative correlation index of -0.2747. The relationship between area and JRS is even weaker, with a positive correlation of 0.2637.

In order to verify the relationship between titles and keywords, the UCINET® was used again.

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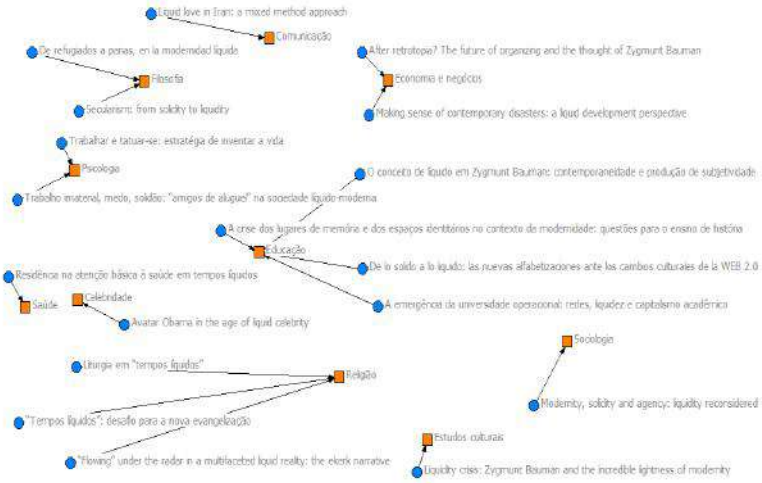

Fig.10: Relationship between titles and keywords
Source: Prepared by the authors, 2019.

Out of the 19 selected articles, two did not show the key terms. The others had between 3 and 6 keywords, and in total, 85 keywords were listed by the authors. Figure 10 shows 17 articles and their relationships with 16 keywords. These were selected for having been used by more than one author, or for having the word liquidity, which directly refers to the theory studied.

'Bauman' and 'liquidity' are the terms that appear the most, being used by 5 authors, followed by the terms‘solidity’ and ‘internet,’ being mentioned by four authors. The other terms that have appeared the most are love, modernity, liquid modernity and immaterial work.

Through the Nvivo® software, we analyzed the higher incidence of words that are cited in the selected articles. The delimited parameters were: 25 most mentioned words, minimum size of 6 letters. As for the grouping, we opted for exact matching terms, with derived words and synonyms.

Terms considered random such as ‘context,’ ‘person(s),’ ‘process(es)’ and also, terms directly related to the theory such as, Bauman, Zygmunt, liquid/liquidity and their variations were excluded from the analysis, since, as they deal with the analyzed subject, they would have greater indecency of citations. The result is shown below.

Fig.11: Word cloud
Source: Prepared by the authors, 2019.

The terms *Modernidade*, Modernity, modern and their synonyms and terms in other languages are cited 568 times. Followed by the terms *Social*, *Sociedade* with derivatives, synonyms and other languages, which are mentioned 466 times. The most used area of Bauman's theory of liquidity was Education, and the terms associated with this area of knowledge are declared 307 times, considering education, study, university and its derivatives, synonyms, and other languages.

Other terms that appeared significantly are related to the Internet, appearing 313 times, considering internet, digital, online and its derivatives, synonyms.

Another point that was raised in the selected articles was the method. It was noticed that the majority of the articles were of bibliographic review, which implies exploratory research of qualitative nature, although many studies do not clarify the type and nature of the research. Out of the

https://dx.doi.org/10.22161/ijaers.69.24 *ISSN: 2349-6495(P) | 2456-1908(O)*

19 articles selected, only 2 pointed out that they are of a mixed nature, i.e., the approach to data analysis was qualitative and quantitative.

As for the data collection instruments, most of them were literature reviews, representing 73.91% of the total articles, followed by a combination of observation and interview with 8.70%, and the combinations interview and documentary analysis, interview and questionnaire, observation, interview and documentary analysis with 4.35% each. A low correlation between the instruments and the nature of the data analysis was observed, 0.3010.

As for the results of the selected articles, only 6 of them show empirical results that corroborate Bauman's theory of liquidity, the others only hold theoretical discussions. The following chart shows what was found.

Chart 3:Empirical studies

Author	Title	
(Perkiss & Handley, 2017)	**Making sense of contemporary disasters**: a liquid development perspective	
United Kingdom	**Economy; business**	**International Journal of Sociology and Social Policy**
The case study and liquid development arguments support our position that the world is not really in a interregnum state, as suggested by Bauman. Instead, it has, and will continue to exhibit, the impacts of liquid development as long as current economic growth continues. Analyzing liquid development using a case study (environmental migration, mainly caused by climate change and rising sea levels in the Pacific Islands) provides an understanding of the social impacts experienced, which is an initial step towards informing the need for change and a social and political account. Using Bauman's understanding on liquidity enhanced by an understanding of the social challenges of development can help researchers understand why the consequences of disasters are amplified and help policy makers respond better to disasters.		
(Joubert, 2018)	**"Flowing" under the radar in a multifaceted liquid reality**: the ekerk narrative	
South Africa	**Religion**	**HTS Teologiese Studies**
The Internet has changed the shape of church everywhere. An 'electronic reform' has occurred, one in which online faith is no longer a novelty; it is a normal part of liquid modernity. Mobile phones, tablets, and computers have opened up exciting new spaces for spiritual connection and expression. Cyberspace is also a sacred space now. The online community is never a substitute for the physical community of believers;thus,ekerk's ongoing involvement with local churches and academic learning places. The liquid church is not about an institution, but about relationship networks. It is not about religious communities hidden in safe havens, far from reality, but about followers of Jesus filling the ethical vacuum created by liquid modernity, incorporating its teachings in relevant ways. We need to provide the message of Jesus in ways and languages with which people in today's liquid world can resonate. We want to be so completely immersed in Jesus' message that temporal concerns are of less importance.		
(DeLuca et al., 2018)	**Trabalhar e tatuar-se**: estratégia de inventar a vida	
Brazil	**Psycology**	**Psychology and Society**
Contextualized in a time and space considered as a modern and liquid (Bauman, 2007), which holds a type of immaterial work that invades lives, we problematize this scenario from the glimpse of individuals who transited with their works exposed on the skin. Therefore, we treat the tattoo as a conceptual character (Deleuze &Guattari, 1992) and analyze it in light of the methodological guidelines of cartography. Thus, it is through the tattoo that the subject 'makes sense' or 'invents' his/her work and life, reflecting on both, understanding them and expressing them. On the one hand, the tattoo marks the moment, the subject, the work, the life, fixing the movement and creating stopping points in this flow. On the other hand, the tattoo itself transits spatially and temporally, transforming itself and transforming the interactions in which it participates. Therefore, it can be a strategy of inventing life to make sense and 'brighten' the work itself, given the desire that arranges life (Guattari& Rolnik, 1986), as a 'materialization' of lifestyles - in this case, an immaterial work so imbricated to lives that it invades and overflows the skin, objectively.		
(Shahghasemi et al., 2015)	**Liquid love in Iran**: a mixed method approach	
Italy	**Communication**	**Mediterranean Journal of Social Sciences**
Over the past two decades, the introduction of new communication technologies has dramatically changed our communication landscape. A result of this new situation is the formation and dissemination of what Zygmunt Bauman called 'Liquid Love.' The first characteristic of liquid love is its possibility of escaping from human bonds. As our study shows, Iranians, as people who live in a traditional society with traditional ties, are eager to experience and even adopt online love. In addition, as zeal for heterosexual relationships increases, so does the amount of time spent on liquid love in cyberspace. We see how users and particularly bloggers have expressed the problems that liquid love creates to put users into despair, depression, loneliness, anxiety, and inability to fulfill their daily routines and tasks. Another intriguing finding in this study is that most of the 63% of Iranian bloggers who expressed pure and negative comments about online love, showed in their comments that they themselves experienced this and that they used to have positive comments about liquid love. We should not forget that, despite the many negative effects and consequences that liquid love has for Iranian users, there are positive		

https://dx.doi.org/10.22161/ijaers.69.24 *ISSN: 2349-6495(P) | 2456-1908(O)*

consequences that should not be neglected. People will find information about other people - possibly different - and therefore learn how to manage differences or, in the best word, fill the differences.		
(Rossoni, 2015)	**Residêncianaatençãobásica à saúdeem tempos líquidos**	
Brazil	**Health**	**Physis: Revista de SaúdeColetiva**
I emphasize that temporariness and uncertainty were remarkable characteristics of the 'space-time' observed, causing insecurity and difficulty in planning training and assistance activities. Despite suffering from temporariness, uncertainty and insecurity, workers and residents developed various forms of resistance and creativity in the daily lives of teams, which enabled them to learn in and from the collective. Thus, the pedagogical documents examined pointed to a training focusing on the user, although the liquid-modern conditions made it difficult to meet this requirement. The national recognition of Murialdo as a training center in primary care and its history did not account for sustaining the investment proposals in basic health units and in hiring and maintaining workers with the state management in that period. Memory seems useless in the 'liquid modernity,' in which a culture of disengagement, discontinuity and oblivion prevails.		
(Grisci et al., 2012)	**Trabalhoimaterial, medo, solidão**: "amigos de aluguel" nasociedadelíquido-moderna	
Brazil	**Psycology**	**Psychology in Study**
In proposing to discuss and point out indicators of loneliness and fear in the current inventory of lifestyles, this research inquired about the ways of existence that make up the current daily life and whether this would comport someone to the point of needing to pay for company. The results corroborate the studies of Bauman (2007a; 2007b; 2009a; 2009c) and Sennett (2007) regarding the liquid-modern society and the loosening of the solidarity ties that are visualized in it, as well as they allow pointing out the immaterial work of the 'Friends of Rent' as an indicator of fear and loneliness in the inventory of the current lifestyles. The immaterial work offered by the 'Friends of Rent' acquires prominence and propagates as an object of easy and fast consumption, within reach; however, it is constituted as a mode of subjectivation or production of lifestyles or ways of existence, by promoting sensations, impressions and perceptions that mask fear and loneliness in the liquid-modern society, as pointed out by Bauman (2007a).		

Source: Prepared by the authors, 2019.

Out of the 6 articles that show empirical results, only 1 of them is from the Web of Science. As for the areas, 2 papers are on Psychology, Economics and Business, Religion, Communication and Health had one work each.

It was identified that, although most of the discussions were in the area of education, none of the empirical studies were in this area. Other areas that only showed theoretical discussions were Sociology, Celebrity, Cultural Studies and Philosophy.

Analyzing the results showed by the authors, although the works corroborate Bauman's theory of liquidity, especially with regard to liquid modernity, the discussions did not reveal a deepening on the theory. It is possible to glimpse that the theory of liquid modernity was used as a background to contextualize the various aspects studied by the authors.

IV. CONCLUSIONS

In view of the information, Bauman's theory of liquidity, despite having been 'launched' around the year 2000, has only been used to support the discussions in the last 10 years.

Through this review, it was also identified that most of the works that discussed the theory are theoretical, which ends up not corroborating robustly with the theory. The empirical researches, although few, converged to consolidate the theory, even when it is used only as a background to analyze and/or justify the phenomena studied. As shown in Chart 3, the areas that developed empirical studies were, a) economy and business, b) religion, c) psychology, d) communication and, e) health.

As for the dissertations and thesis, these also use more Bauman's theory as a scenario to contextualize the phenomenon studied.

Responding to the objective of investigating the Theory of Liquidity and its relationship with management aspects, it was noticed that only one work in the area of economics and business was found:

Making sense of contemporary disasters: a liquid development perspective, which aimed at "[...] it is to explore the economic conditions of contemporary society to provide information on the ways in which the consequences of disaster, including environmental migration, are accentuated." Thus, it was identified that no empirical study was actually performed in the area of management.

There are no studies focused on agriculture, administration or family farming. Thus, as a suggestion for future works, it is proposed to study the areas of administration focused on agribusiness in its most varied sizes in this liquid society.

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https://dx.doi.org/10.22161/ijaers.69.25 *ISSN: 2349-6495(P) | 2456-1908(O)*

Personal Marketing in the Exercise of the Profession Lawyers in Cacoal City, Rondônia/ Brazil

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Abstract**—** *The current Brazilian labor market has become very competitive, leading professionals to develop actions and behaviors that strengthen a positive and competent image on their part, thus transforming names into brands known and respected by society. This paper studies the influence of personal marketing in the practice of lawyers in the municipality of Cacoal, Rondônia. The data result from descriptive research that took both qualitative and quantitative approaches to itsbibliographic research and deductive method. A questionnaire with multiple choice closed questions was distributed via e-mailwith the aid of the Google Forms electronic tool. It was found that lawyers consider marketing as of fundamental importance for career leverage, showing that reputation and interpersonal relationships are considered primary adjuncts to the practice of law, although law professionals were observed to use personal marketing sparingly.*

Keywords**— Personal marketing. Lawyers. Professional success.**

I. INTRODUCTION

In the current scenario of rapid changes in the business world caused by globalization and the fast advance of technology, professionals need to be increasingly updated and well prepared to meet the demands of the labor market.

Lanzarin and Rosa (2012) describe all areas of the labor marketin today's society as highly competitive, not only in educational terms but also in the way thatpeople present themselves, communicate, or demonstrate their knowledge.

In this regard, lawyers, among other professionals, follow a profession using from the applied social sciences, in which the administration of justice is essential, according to article No — 133 of the Constitution of the Federative Republic of Brazil of 1988. Marketing as an exercise in advocacy is little explored among law professionals, although its use could foster the idea of professional prominence in a competitive and demanding market.

Thus, defining the research problem raises the following question: What is the influence of personal marketing on the practice of lawyers registered in the Brazilian Bar Association, Rondônia section, who are active in the city of Cacoal?

The general objective was to study the influence of Personal Marketing in the practice of lawyers working in the city of Cacoal. The specific objectives include verifying the importance attributed to personal marketing by the professional lawyer, to investigate if these professionals have specific knowledge in the area of marketing, identify the attributes related to personal marketing, essential for the legal professional and list the main types of relationships used with clients, by this category.

https://dx.doi.org/10.22161/ijaers.69.25 *ISSN: 2349-6495(P) | 2456-1908(O)*

According to the Brazilian Bar Association (OAB) (2018), the country's legal staff currently consists of 1,090,227 professionals and, as mentioned, this number has been steadily increasing.

This makes the competition increasingly fierce and leads these professionals to be increasingly concerned to develop specific activities that will use personal marketing as a differential in pursuing professional eminence.

II. THEORETICAL FOUNDATION

2.1 MARKETING CONCEPT

The word marketing today has several meanings because it has varied applications. Some think at marketing means selling or advertising, nothing more.

But according to the New Dictionary Aurélio (2004), marketing is a set of strategies and actions that allow the development, launch, and support of a product or service in the consumer market.

Marketing can be understood as the art of finding how best to publicize, an image, a product, or a service. It refers to current interaction between a company and its internal and external consumers.

It has emerged to simplify the lives of people, businesses, and institutions by being an art of highlighting and satisfying needs, and analyzing and developing plans for persuading individuals or collective communities by targeted actions.

2.2 PERSONAL MARKETING

Throughout history, the concept of personal marketing has been variously defined in the work of many scholars in their approach to no simple task. Several distinct interpretations can still be found.

For Ritossa (2009), personal marketing means spreading the image of a certain product so as to give members of a society a chance to integrate it into their plans.

The concern for properly positioning goods before the public was one of the differentials that professionals began to look for, along with marketing concepts,among the concepts of communication, as strategies for achievementwere being developed. The text below, summarizes some essential strategies in applying the idea of personal marketing.

- **PhysicalAppearanceandPosture**
  According to Silva (2008), the image of the individual is founded on first contacts; it will depend mainly on the way someone is dressed, as well as looks, behavior, posture, voice, elegance, verbal expression, attitudes, and self-confidence.
- **Communication**
  For Ritossa (2011 p.100), communication can occur in several ways. In addition to the messages conveyed through words, our gestures, tone of voice, look, dress, posture, and patterns of behavior are in the same category of transmitted signals.
- **Self-knowledge**
  Individuals must have a perception not only of the world around them but of themselves, plus everything they know how to do; this is all related to their core attributes. With these, people move towards self-knowledge and self-confidence. Then what distinguishes them from others stands out to be valued in the job market and their personal lives (SILVA, 2008).
- **Interpersonalrelationships**
  Building a network of relationships is a natural skill used by some to structure this network more efficiently. Building this network requires patience, but is not impossible. Determination, planning, and objectivity are needed by anyone who wants an active network (RITOSSA, 2011 p. 105).
- **Createvalue for yourbrand**
  According to Lima (2016), the brand that emerges will be the differentiation of the professional in the market. If it is already defined, it is essential to make sure it has a big name and a positive impact.
- **EthicalConduct**
  According to Nicolai Hartmann (see NALINI, 2009, p. 20), ethics is a normative discipline, not for creating norms, but for discovering and elucidating them. This premise allows us to verify that conduct contributes to the various aspects and variants in the growth of individuals, becoming a differential for some individuals from their colleagues.
- **EducationalImprovement**
  Attending congresses, seminars, and symposiums brings professional development. The publication of articles in specialized magazines, newspapers and books is a way of conveying credibility, as well as reflecting which professionals can measure their rate of production in terms of (BORDIN FILHO, 2013).
- **Career Planning**
  According to Sousa Pereira (2011), personal marketing involves essential features for achieving success, such as personal power, interpersonal relationships, leadership, reputation, trust, determination, honesty, security, ethics, physical appearance, personal image, persuasion,

https://dx.doi.org/10.22161/ijaers.69.25 *ISSN: 2349-6495(P) | 2456-1908(O)*

motivation, empathic communication, personal branding, work experience and circles of influence.

To do well in such a competitive market, it is not enough to be right; a professional must be excellent. Planning well-crafted ways of personal marketing generates new job opportunities, since visibility is a crucial factor in career development.

The best way to attain professional goals is from a structured planning perspective, to develop a mission, preset levels, or a specific level, always setting new goals and objectives for one's future of career.

2.3 PERSONAL MARKETING AND ADVOCATORY ACTIVITY

According to Cappellari (2012), marketing in a lawyer's life is essential for him to meet his competitive and strategic goals, and also follow a path tat brings success. In this sense, each member of the legal professional must devise and build a personal brand in their sphere of work, since this will be their primary way of maintaining a stance when challenged.

It can be said that the image of a professional lawyer. Being in the right place at the right time is also, essential since opportunities can arise from anywhere.

Thus, trivial encounters should not be underestimated, for a whole network can develop from a fascinating individual, and the use of one's network should not appear to be immediately "interesting" (PELICA, 2011).

However, lawyers should not make unrestrained use of marketing. The OAB Code of Ethics and Discipline, in Articles 28 to 30, puts several restrictions on the use of advertising to publicize the professional services of this group. According to Nalini (2009, p.370), these professionals are allowed to advertise their functions but should do so with discretion and moderation. The purpose of advocacy advertising is for information only, and disclosure in conjunction with another activity is prohibited.

This code already promulgates a model of discreet and moderate advertising, and professionals' announcements may include only their full name, OAB registration number, references to professional and academic titles or qualifications, addresses, hours of service and media contacts.

III. METHODOLOGY

The present research was exploratory and descriptive; it was concerned with knowing the possibilities of categories and then classifying them, describing them and comparing them with the data obtained, as defined by Nascimento et al. (2018).

The descriptive research of the present paper had a deductive purpose. The strategy employed may be described asmixed-method: a) qualitative, which, according to Piacentini et al. (2018), seeks to discover and classify variables based on their relationship; and b) quantitative, which according to Fonseca (2002), brings in mathematical language to describe the causes of a phenomenon and the relationships between variables. As a procedure for data collection, extensive bibliographic research was conducted with marketing-related subjects, focusing on the personal marketing used by lawyers.

A script containing ten closed and multiple-choice structured questions was distributed by e-mail. The subjects of the research were the lawyers registered at OAB/RO,acting in the city of Cacoal.

The study population totaled 500 (five hundred) regular lawyers, according to the information provided by the Order's subsection in the municipality of Cacoal. However, since this was an informal survey using a digital tool, 155 lawyers answered, representing a percentage of 31% (thirty-one percent) of the total.

The survey was conducted in the municipality of Cacoal - Rondônia, which has, according to estimates by the Brazilian Institute of Geography and Statistics - IBGE (2017), approximately 88,507 (eighty-eight thousand, five hundred and seven) inhabitants. Data were analyzed and explained through charts and graphs for illustrative purposes.

IV. RESULTS AND DATA ANALYSIS

The survey was conducted in July 2018 and showed that 67.7% of lawyers were then between 26 and 40 years old, 25.2% between 41 and 59 years old, and 6.5% aged up to 25 years. Regarding gender, 57.4% are women. 52.4% graduated from private educational institutions.

At the time, 45.2% were self-employed, 40% worked in private companies, 11.6% held public office,while 3.2% were self-employed and held public office.

The data obtained in the survey reveal that practically all respondents (94.2%) had some knowledge of marketing. When asked explicitly about personal marketing, 36.8% of them claimed to have little knowledge about the subject, whereas 25.2% claimed to a thoroughly knowledge of the subject6. However, most respondents realized its importance: 81.2% considered it of tremendous or fundamental importance.

According to the interviewees, the main and essential factors at present involved in choosing a lawyer were (in

https://dx.doi.org/10.22161/ijaers.69.25 *ISSN: 2349-6495(P) | 2456-1908(O)*

order of choice) reputation (40%), length of professional experience (30.3%), safety (11.6%) and ethics (9%).

When asked about the crucial elements for a lawyer, the research identified the following: the network of relationships (67.1% of agreement), followed by expertise in the area (16.8%), self-knowledge (7.1%), speaking ability (3.9 %), writing skills (3.9%) and, last, physical appearance and posture (1.3%).

However, when asked about the necessary actions needed to practice the profession, all the items were listedby the respondents, as fundamental. In order of importance, interpersonal relationships came first (91%) with career planning representing the lowest percentage (68%) as set out in detail in the table1.

** Caption: (f) = Absolute Frequency; % = Relative Frequency.*

Table 1: Actionsrelatedtopersonalmarketig
Source: Research data (2018).

ActionsUsing	***Knownactions***	***Actionstaken***
	t	*Zt*
Phone calls	141	107
Business cards	136	99
Facebook, Instragram	128	85
Emails	121	73
Notused	116	43
Others	116	43
Listingn thephonedirectory	112	23
Internet Website	106	9

Among the ways of disclosing details of work or communication between professionals and clients, the following stand out: telephone contacts, attracting 69% of opinions.

Other types of exposure used by professionals were business cards, followed by social networks, entries on Facebook, Instagram, and LinkedIn, and e-mail.

Research participants were asked about their knowledge of marketing elements and which ones they used most often – more than one option could be chosen. Thus the frequency of responses is relative rather than absolute, as shown in the Table 2.

Table 2: Relationship between Knowledge and Personal Marketing Elements
Source: Research data (2018).

Description of elements	**The score obtained by the degree of importance 1 (most important) - F ***	**%***
Interpersonalrelationships	141	91%
Ethicalconduct	136	88%
Educationalenhancement	128	83%
Communication	121	78%
Physicalappearanceandposture	116	75%
Self-knowledge	116	75%
Creating value for your brand	112	72%
Careerplanning	106	68%

Comparing the data described in the Table, the relationship between knowing and using is high, especially as regards Facebook, Instagram, business cards and phone calls, which are described as being most often used by these professionals. The most significant discrepancy concerned website use.

II. CONCLUSIONS

Personal marketing is understood as a strategy that can be started at any time. All professionals can use this new tool to boost their careers and successfully pursue the profession in an increasingly competitive marketplace.

The information gathered from this study demonstrates the beneficial aspects of personal marketing in the practice of law. The professional and personal success of lawyers is more or less linked to the image of this group that is conveyed to society. Undoubtedly the important thing for the Brazilian legal market is to appear to be a good lawyer who is also good at all the resources of his profession, highlighting his name as a mark of quality and competence. However, to convey a positive concept, a lawyer must build an excellent professional, social and personal image, by such means as his posture, excellent communication, way of life, self-knowledge and perception of how society sees him. All the research objectives were achieved.

In addition to these factors, it may be pointed out access to online application instruments distinguishes younger lawyers from old ones. Older professionals resist

https://dx.doi.org/10.22161/ijaers.69.25 *ISSN: 2349-6495(P) | 2456-1908(O)*

this tool, as evidenced by the number of younger lawyers who responded to the survey (74.2% were up to 40 years old, compared to 25.8% over 41 years old). Younger lawyers consider the number of lawyers who believe in their name to represent a brand, and believe in the importance of personal marketing for a professional career. However, some of the limitations and restrictions imposed by the OAB Code of Ethics prevent them from making use of this career leverage tool.

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https://dx.doi.org/10.22161/ijaers.69.26 *ISSN: 2349-6495(P) | 2456-1908(O)*

Innovation as a cross-cutting Competency in transforming Grey Literature as a tool in Training for Engineers

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Abstract— *The aim of this work is to present a study which particulars the importance of storage of the content generated from searches of TCC's of graduate programs in engineering like Grey Literature of the higher education institutions in Brazil and submit the Institutions repository as innovation strategy to contribute to the development of transversal competence of the engineer. The study presents an aggregator mechanism to higher education emerging as lever of "innovation using the transversal competence in engineering and technology "noting-if the stimulation to the cultural creation and the development of scientific spirit and reflective thinking, encouraging the research and investigation. The main objective is to discuss about the need for a study to characterize the research that generate the work of completion of courses in Engineering higher education institutions in Brazil and submit the Institutional Repository), as a strategy for innovation in order to contribute to the development of transversal competence of the engineer. The discipline of projects of completion of course in engineering contribute so relevant to the professional future, once the same, while student, on the identification of a problem, learn how to get information from research, readings, reflections, discussions, among others, to respond to their needs, reducing uncertainty and promoting a new knowledge registered on the work of conclusion of course.*

Keywords— Engineering; Grey Literature; Innovation; Institutional Repository, Learning.

I. INTRODUCTION

Among the purposes of higher education in most engineering courses, this work focused on investigation of the format of TCC's (work of completion course) and accomplish following purposes: a). Stimulate the creation and cultural development of the scientific spirit and reflective thinking; b). To encourage research and scientific research aimed at the development of science and technology and the creation and dissemination of culture, and thereby develop the understanding of man and the environment in which he lives; c). Promote the dissemination of the cultural, scientific and technical knowledge that constitute heritage of humanity and to communicate knowledge through teaching, publications or other forms of communication (Souza; Silva, 1997)

Second Coast (2006) the system of scientific communication has significantly suffered the impact of electronic media, most recently with regard to open access to scientific literature. In this sense, electronic scientific journals to open access and institutional repositories increases the dissemination of the research of exponential mode, maximizing its impact, its visibility and its advance.

To start the production process of an article, the specialist produces sketches of his ideas for comments among their peers. This procedure, originally made only between researchers, was enlarged and developed with the emergence of the archives and open access repositories. These technologies offer a more functional organizational structure of literature than the current existing organization in the process of revision among peers.

The Final Projects and the work of completion of courses (TCC's) higher education institutions should be considered as real "diamonds" with informational content that can be lost, due to lack of proper management of this

https://dx.doi.org/10.22161/ijaers.69.26 *ISSN: 2349-6495(P) | 2456-1908(O)*

source of information. Petinar (2007), mentions that the open-access repositories, would allow all Community (academic or otherwise) to have access to the first research initiatives (monograph of graduation), elaborated and developed by graduate students, collaborating with the dissemination of scientific knowledge.

The specific problem of LC resulting of works and researches, that are generated by the work of completion course and the Final Projects of graduate in engineering, in addition to the graduations, in General, are normally delivered only printed and in digital form, catalogued and entered in the system by the Librarian, in general are not made available in electronic media only appearing cataloged information of the work, which ends up causing delay in search of that content. For a user (researcher, teacher and student) have access to Final Projects, is impractical. Another question is how the visibility of the scientific production of the graduate, and consequently on the part of researchers and teachers. This inoperative process transforms innovation in Grey Literature.

The Institutional Repository must contribute to the community to have access to the first research initiatives (TCC's and Final graduation Project), developed by undergraduate students. (Pertinari, 2007).

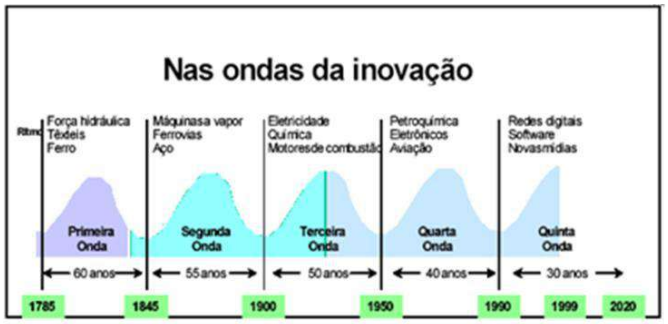

Fig.1- Technological innovation through the ages
Source: The Economist; Bussinger (2000).

The aim of this work is to present the discussion of how the RI must contribute to the development of innovation in undergraduate program in engineering, based on the search engines that do not allow that despise the contents of research of technological innovation that are formed by TCC's and Final Projects of undergraduate courses in engineering.

The search for novation is an investigation imbued with difficulties to achieve. Let her get lost is not consider its importance. The ranges of the waves that classify innovation from the point of view of research, are approximately ten years. The waves of innovation of Bussinger, starting in 1785, with the emergence and predominance of the use of hydraulic forces, textiles and iron. Then, until the beginning of the 20th century, appears the second wave, with the predominance of steam engines, the railroads and the extensive use of steel.

II. THE REPOSITORY (IR) AS AN INSTRUMENT OF INNOVATION

Scientific and technical activities are responsible for the production of knowledge that will become, after registered, on scientific and technical information. Second, Le Coadic (2013), conversely, activities, only come true by this information.

Considering that this lever must move freely to produce knowledge, if there is a treatment of the sources of information produced by the University, you lose the knowledge. In this context, the University's Mission is the socialization of knowledge, the democratization of education that with programs of citizen class and team Enactus, incubators, junior consultancy. The University of RI's scientific production is available to socialize knowledge and democratize quality scientific information in relation to society.

The Enactus Cefet / RJ team has been conducting social entrepreneurship projects for 13 years. Enactus is a worldwide non-profit organization made up of young college students, teachers and business leaders who aim to develop social projects using the positive power of business. It enables progress through entrepreneurial practice - the program has more than 70 teams in Brazil struggling to empower socially vulnerable communities - anchoring its principles in the practice of sustainable development.

Access to information creates possibilities for changes within society. "Therefore, the access to information and knowledge is regarded as a fundamental component to the exercise of citizenship in a democratic context" (Vitorino; Piantola, 2011).

The fact that this knowledge is not available to society, defined as Grey Literature:

"(...) the term Gray Literature is used to designate non-conventional documents and almost published, produced in the areas of Government, academics, business and industry. (Gomes; Marin; Sharma, 2000)"

Machado (2005) mentions the peculiarities of Grey Literature are: do not have records on the intelligence agencies, not through commercial sources, have simple production mechanisms, are in universities, research centers and reach a small audience. Campello (2000), reinforces that although universities and colleges, research fostering agencies, ministries of education and of science and technology is committed to disseminating these publications, its visibility is still very restricted.

https://dx.doi.org/10.22161/ijaers.69.26 *ISSN: 2349-6495(P) | 2456-1908(O)*

III. THE CONSTRUCTION OF INSTITUTIONAL REPOSITORIES AS EFFECTIVE INSTRUMENT FOR INNOVATION IN ENGINEER TRAINING

The discipline of projects of completion of course in engineering contribute so relevant to the professional future, once the same, while student, on the identification of a problem, learn how to get information from research, readings, reflections, discussions, among others, to respond to their needs, reducing uncertainty and promoting a new knowledge registered on the work of conclusion of course. This work also demonstrated that as guidelines of higher education have contributed to the future student in professional terms, because there is no process of teaching and learning, the commitment to develop on individual an investigative and reflective side doing the same, in front of a particular problem or challenge in his professional life, evaluate possible solutions based on scientific units, reproducing consciously or unconsciously, the steps taken at graduation when it developed its TCC.

The visibility of scientific and technological knowledge through the RI, demonstrates that the globalized world produces, at a pace never seen before, a huge range of scientific and technological knowledge. As a result, there arises the concern with its dissemination, availability and preservation. To Rocha (2006), the change in search processes and use of information generated faster and more efficient forms of information retrieval. The media as paper and magnetic metallic surface disintegrate or may become unrecoverable, and the digital objects minimizes the action of time on the physical media. With this, ensure the availability of information, however, these must not be left in obsolete formats for long periods, requiring updating.

IV. THE CONSTRUCTION OF THE INSTITUTIONAL REPOSITORY (IR)

The construction of an institutional repository involves steps of planning, deployment and operation. These three phases are interdependent and consist of activities that must be met in order that the construction initiative of the institutional repository is successful. Of course, this is not the only way to build institutional repositories, but the proposed scheme covers relevant aspects that should be considered in this kind of venture. This document will stop the discussion of some aspects of the proposed phases for Leite (2009), seeking to present a set of best practices for the creation and management of institutional repositories.

a) Planning

In step is very important to develop and implement an institutional policy for the operation of the institutional repository. The operating policy should reflect decisions taken throughout the store planning. It is recommended that this policy is in line with those already in effect in the library and in the institution.

b) Definition of Institutional Repository policies

The policy should address the objectives of the repository, must contribute to the definition of the service, determine the formation of the team responsible for the implementation and maintenance of the repository and on the deadline set for the deposit in the repository. It must also contain the kind of material that will be deposited, as well as those who are not part of this system. The repository operation policy also should establish, who should make the deposit, the responsibilities in the workflow, and all other aspects that institutions consider that should come to contribute/ensure their operation of the repositories.

c) Structure of the institutional repository

Is in the planning phase should be designed the information architecture of the repository. It is understood as information architecture, in this case, the Organization of content. Each institutional repository organizes content in a way that best fits your needs by adjusting the structure of the RI to the operation as a whole.

d) Institutional Repository deployment

The deployment step must be observed the following aspects: the metadata that have the purpose of register of journal articles; papers presented at academic events; Book chapters; Book and according to purpose of this study, registering also the contents of TCC's of engineering and also establish rules for standardizing the most used document formatting.

The ideal scenario is that intellectual production of the institution were stored and could be freely distributed on the Internet. However, the copyright of the content assets, especially most articles published in scientific journals, are the property of scientific editors. It is interesting to understand the aspects of copyright in order to avoid problems.

V. CONCLUSION

The research points to promote evaluation with statistical basis proposed institutional repository model, because, as any information system, you will need to go through some benchmark for comparison, in order to improve fragile aspects and identify their points of success and opportunities for improvement, considering mainly the aspects that will be used as indicators of quality.

The open access repositories allow the whole community (academic or otherwise) has access to the first research initiatives (TCC of graduate), elaborated and

https://dx.doi.org/10.22161/ijaers.69.26 *ISSN: 2349-6495(P) | 2456-1908(O)*

developed by students, collaborating with the dissemination of scientific knowledge. The Institutional Repository (IR) is a strategic instrument, contributing to that the community has access to the research developed by graduate students, through its Work of conclusion of course (TCC's), transforming contents considered as Grey Literature (LC) in scientific research as knowledge production.

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https://dx.doi.org/10.22161/ijaers.69.27 ISSN: 2349-6495(P) | 2456-1908(O)

Discipline Monitoring Program to Undergraduate Students: A system that to Secure the Academic Experience and a Higher Education of the Quality

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Abstract**—** *This article serves as a result of a research carried out on the Academic Monitoring Program that is a teaching-learning platform of the São Camilo University Center, located in the City of Cachoeiro de Itapemirim, in the State of Espirito Santo. A total of 141 monitors were contacted who presented themselves or were currently providing academic monitoring. Academic monitoring instructions, from its inception, underwent numerous transformations and adjustments, reaching up to the system we currently have, but this fact has not eliminated the need for further adjustments. research has merely gotten information on the monitors who were part of this program to know if they have this program if you think the program is at its fullest or if it makes some modifications so that all the expected esper in its idealization. Approximately 90% of the interviewees declared the monitoring program of previous years and only 10.5% declared that they were participating in the program during the semester (2018), which allows inferring a small participation over time; This is just a high end in the development of monitoring for quality, being in capacitating for monitors, inimed for the academic monitoring and incentiving the monitoring classes.*

Keywords**— Monitoring, University graduate, Quality education, Methodology.**

I. INTRODUCTION

The student monitoring system emerged from 1968, with the creation of Federal Universities, through Federal Law no. 5,540, which was instituted on November 28, 1968, where it established norms for the operation of higher education and also in its article 41 academic monitoring (Lins et al, 2018).

After its legal implementation in the educational field, academic monitoring expanded and took its place in several universities throughout the country, being a fundamental part of higher education courses and even part of the political pedagogical project of each course, making it effective (DIAS , 2007).

The program allows many students to have access to this system, allowing educational indexes related to teaching and learning to undergo a major transformation and many monitors can receive incentives for teaching career.

The academic monitoring, the aim of this work, is primarily a system where, through a selection method, students from various courses are selected and that, upon their approval in this process, can, together with the

https://dx.doi.org/10.22161/ijaers.69.27 *ISSN: 2349-6495(P) | 2456-1908(O)*

teachers of the subjects assist students in doubt. and especially deepen their contents even more (COSTA; ARAÚJO, 2014, 2015).

The academic monitoring system, among other things, has two main objectives, the first is to establish a relationship between experience and teaching, thus generating an individual more familiar with the experience in the classroom and also an improvement in the level of education offered by the Higher Education Institution (IES) (NUNES, 2007).

Even with all the dissemination of the academic monitoring system, it can be seen that it has some flaws that become evident only to the individuals who are directly linked to this system, the monitors and students. Because of this fact, this article assumes that to get the best out of the program, more information is needed on how the program is viewed by its executors, the monitors.

In so reviewing, the target audience for this article received a form containing questions about their progress and their purpose upon joining this program, in order to receive feedback on how it is viewed by its performers.

Brazil is the world's largest consumer of pesticides. This is due to the tax incentives derived from public policies to the pesticide product, applying the policy that allows tax benefits to the use, marketing, production and importation of pesticides (MELO, 2016) as public policies to encourage agricultural poisons that occur through extrafiscality, which in turn are tax rules used as a means of influencing human conduct in the purchase of such products (VEIGA; MELO, 2016). Extrafiscality is negative when incentives, tax exemptions and subsidies in the marketing of pesticides are provided (CAVALCANTE, 2014).

Thus the objective of this research is to analyze the monitoring program, as a way to enable an understanding of the way it is being performed, what are the problems that individuals consider relevant and especially their opinions about possible improvements that the program needs.

II. MATERIALS AND METHODS

This research was elaborated and applied at the São Camilo University Center in Espirito Santo, at campus I, located in Cachoeiro de Itapemirim, Paraiso neighborhood in Espirito Santo State, Brazil. a British educational institution as diverse areas of practice among Bachelor, Degree, Engineering and Technology offering 23 distinct courses.

In summary, the research has a descriptive and exploratory characteristic, because according to Gil (2004, p. 42) “Descriptive researches are, along with exploratory ones, the ones that social researchers are usually concerned with about practical action. They are also the most requested by organizations such as educational institutions [...]. ”Due to the practical performance developed during the Academic Monitoring Program of the aforementioned University Center, the target audience consists of academics enrolled in the institution, initially directed from of the 2nd period.

The method of collection was through a questionnaire developed on the Google platform, better known as Google Forms, enabling an interview with the academics involved. Were selected for research, academics who fulfilled in 2016 and 2017 or who is currently included in the monitoring program, ie in the 1st semester of 2018.

The questionnaire was made available to the monitors online from the platform mentioned. For this, the data collection process was performed directly in the approved registration forms, made available by the academic monitoring department of the University Center, where the data were collected in the attachment folders exposed by the sector.

The number of monitors present in the records made up a total of 171 individuals approved in the years mentioned above, but about 28 of them did not have enough data to contact them and another 02 could not participate in this research, as they were members of the current research team, remaining a sample of 141 individuals able to be contacted. Of this total, only 38 monitors answered the questions in the stipulated period, so this research will work with data provided by approximately 27% of monitors who were contacted throughout the survey, where 73% chose, for unknown reasons, not to participate in this survey.

For statistical purposes, the number of monitors who volunteered to answer this questionnaire, which represents the number of 38 individuals, will be used as 100%.

The questionnaire consisted of 7 personal data confirmation questions and 9 questions about the monitoring system itself, enabling the analyzes that will be contained during this research.

The interview consists of a questionnaire characterized by direct closed questions, and also containing discursive questions, developing qualitative and quantitative results.

The data are made in a quantitative and qualitative way, because the closed questions provide statistical data to be evaluated more directly obtaining quantitative result, through the percentage analysis, while the discursive one provides a qualitative result to be worked on their individuality and on their own the social aspect.

https://dx.doi.org/10.22161/ijaers.69.27 *ISSN: 2349-6495(P) | 2456-1908(O)*

III. RESULTS AND DISCUSSION

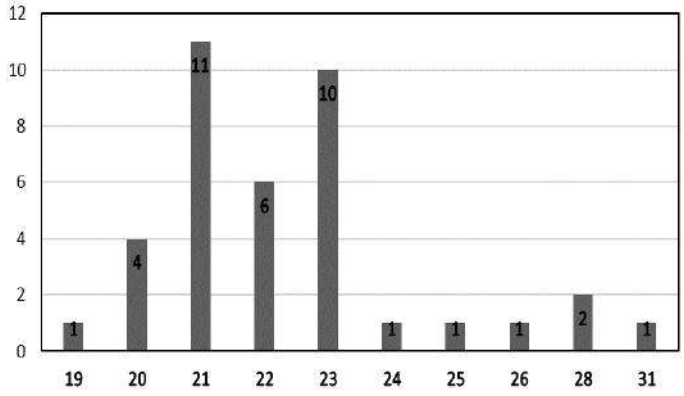
3.1 Research target profile analysis

The research on the Academic Monitoring System was designed to be carried out with all monitors from the years 2016, 2017 and the first semester of 2018, which were in the records of the São Camilo University Center – Espirito Santo, Brazil.

The participants who answered the questionnaire in their entirety are in the age group of 19 to 31 years, where most of them are from 21 to 23 years, about 71% of respondents, data that can be better analyzed in Graph 1.

As stated in the introduction of this paper, academic monitoring is a program that allows students from various higher education courses to have an experience with the teaching area. In this research we collected data from monitors who belonged to a wide variety of courses.

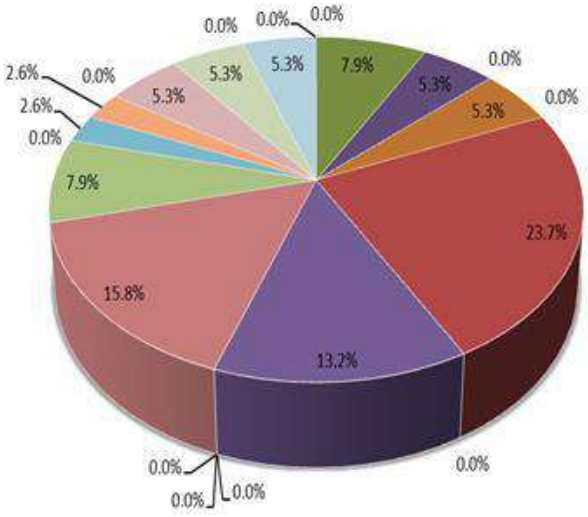
Graph 1 - Age of Research Participants



Source (The author, 2019)

In Graph 2, it can be observed that about 23.7% of respondents belonged to the Nursing course, 15.8% to the Pharmacy course and 13.2% to the Civil Engineering course. These three courses made up about 52.7% of respondents, ie more than half of the monitors in 2016, 2017 and 2018 were distributed among them.

Graph 2 - Distribution of Monitors by Course



Source (The author, 2019)

In addition to this fact we can see that other courses are represented in this chart, even with an inferred number of monitors, such as mathematics, letters, history, psychology and more.

In addition to the students' home courses, the subjects in which they conducted the academic monitoring program were collected. It can be observed that from the data collected that in relation to the monitoring subjects are very well distributed among the monitors, as there were few occurrences. double or triple monitoring in the same discipline, which was found in the disciplines of Semiology and semi-technique, with 4 monitors; Basic immunology, 3 monitors; Biochemistry and English Language: Oral and Written Expression with 2 monitors.

The other subjects covered with monitors were: Analysis of Isostatic Structures, Applied Biology, Cell Biology, Colony Brazil, Calculus III, Calculus II, Constitutional II, Advanced Accounting, Embryology, Stage I, Pharmacognosy, Physiology, Human Physiology, Fundamentals in Social Psychology Institutional, Genetics, Geriatrics and Gerontology, Clinical Hematology, Hydraulics, General History, Basic Mathematics in the courses of Biology and Accounting, Solid Mechanics, African World, Organic Chemistry and Dietary Technique.

https://dx.doi.org/10.22161/ijaers.69.27 *ISSN: 2349-6495(P) | 2456-1908(O)*

About 90% of respondents said they had completed the monitoring program in previous years and only 10.5% said they were participating in the program during the semester, which makes it possible, in a cursory analysis, to say that the number of monitors has decreased considerably. When making the arithmetic average of the total sum of monitors and dividing by the 3 years that were used in the research, and considering a hypothetical reality that the inscriptions remained constant, the expected percentage would be approximately 34% each year, about 23%. below the arithmetic average in 2018.

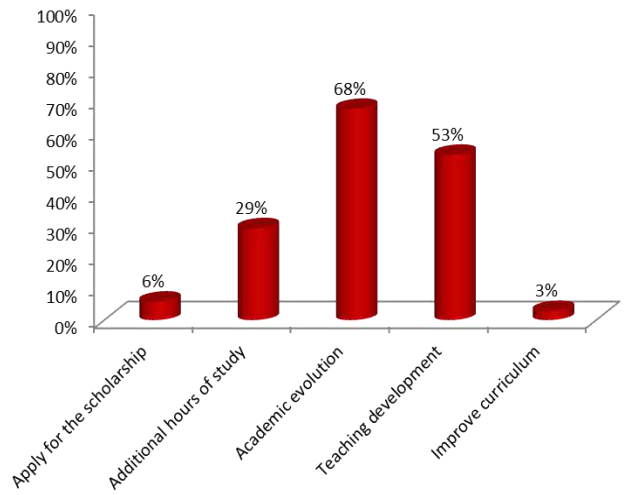
3.2 Expectations, relevance and possible developments

The search for entry into the academic monitoring program can be motivated by several aspects, which will be shown in Graph 3, where it aims to demonstrate the main reasons that led the students to participate in the monitoring program, which may be through the scholarship offered, academic development, recognition, complementary hours and among others. This multiple choice question enables the student to give his opinion on the alternatives he thinks fit.

Graph 3 shows the results of the students who have already completed the process. We see that 5.9% of the students wrote in the program to apply for the scholarship. However, 29.4% of the answers generated by 10 students answered that the reason was for deduction. of complementary hours. In the middle, 2.9% of the answers allowing a respondent, said that participated in the program to improve the academic curriculum.

With higher results we have the alternative of academic evolution, alternating for 67% of the answers, obtained by 23 students, according to Lins et al. (2018) being a monitor reflects an intellectual advance towards academic evolution, as it develops an exchange of knowledge between students. advisor and student monitor. In this way we make it possible for the majority of academics who were once monitors then in burqa of a development in knowledge, in the contribution made in knowledge exchange. And finally, the development option in the teaching area, thus 52% of the answers with 18 students.

Graph 3- interests in the program

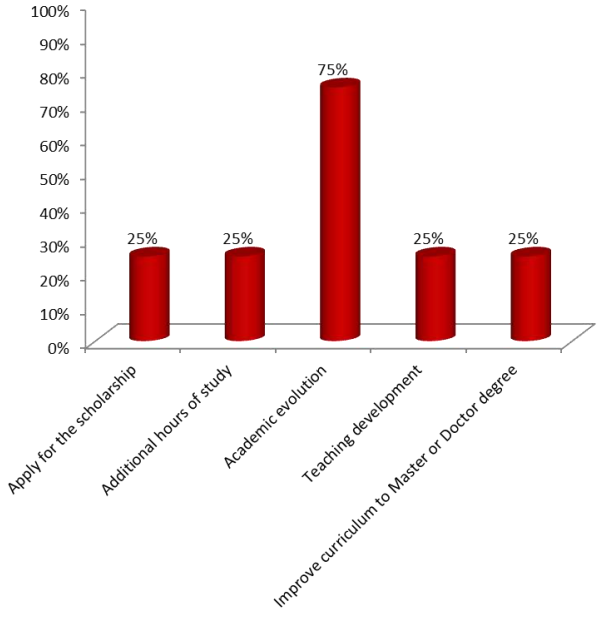


Source (The author, 2019)

Already the graph 4, has the same purpose of the graph mentioned above, but the target audience intended for monitors in process in progress in the period 2018/1.

You can see in this Chart that we get four of the five alternatives with the same 25% percentage rate referring only for one answer, they are the alternatives, apply for the scholarship, deduction of complementary hours, development in the area of teaching and lastly improvement of the curriculum. academic. And as we see the most voted again and the alternative that is attributed to academic evolution. We can buy graphs 3 and 4, and their consistent relationship between the most voted alternative among monitors is evident.

Graph 4- interest in monitoring 2018/1



Source (The author, 2019)

https://dx.doi.org/10.22161/ijaers.69.27 *ISSN: 2349-6495(P) | 2456-1908(O)*

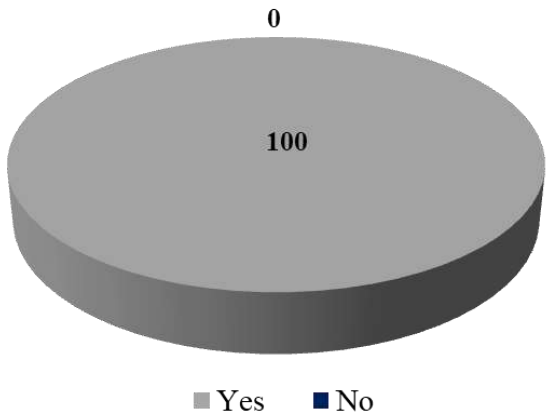
Already the graph below representing (Graph 5), referring to the second question of the questionnaire, reveals the importance of monitoring projects in the academic formation, emphasizing yes 100% of the answer of the 34 academics who will conclude the program said it was relevant to the formation as presented in Graphic.

Graph 5 - Importance of the Program

Source (The author, 2019)

We can analyze that in Graph 6 presents the answers of the students who are still in the process of progress in the program and they 100% believe that the monitoring will be relevant to their formation. Therefore we can compare the result analytically, because who is with the process in progress realizes that the program will be important for its formation, and as a validation validating the result of Graph 5 that are monitors who have already completed the process and said it was well relevant.

Graph 6 - Relevance of the Monitoring Program



Source (The author, 2019)

Finally, one of the questions with emphasis on the expectations and relevance of the monitoring process, dialogues on the way the program has aroused or is arousing interest in the area of teaching. It develops methodological practices that it attributes to teacher development. The role of the monitor in the teaching and learning process enables the student skills and competences to arouse the incentive to teaching, says Oliveira and Maziero (2013).

Thus, we can evidence that the monitoring process at the University Center arouses a look at teaching, because due to the results obtained we get as a response that 79.4% corresponding to 27 interviewed, will state that during the performance aroused interest in the teaching career and About 20.6% corresponding to 7 students stated the opposite, which did not arouse interest. According to Nunes (2007), this lack of interest can be triggered by the devaluation of the monitor within the educational institution, leaving the student restricted to the teaching functions and the teaching-learning process.

As a comparison we see that the ongoing process monitors that 75% being 3 students are developing an interest for teaching and only 1 respondent constituting 25% is not developing any interest in teaching.

It can be pointed out that the development and exceptional practices of the project are being very favorable for a good performance due to the questions and answers obtained above. According to Oliveira and Maziero (2007, p.1823.) "[...] the monitoring substantially favors teaching, so as to positively assist in the teaching and learning process, which denotes an activity rooted in the precepts of extension activity [...] ". Such action for the relevance of the project attributes to the development of practices influenced by the monitoring project.

3.3 Influences generated by the academic monitoring program

In addition to all development achieved from the program itself, attention should be paid to the evolution that the program should lead to the individuals who are inserted in it, the monitors themselves and also the students who make use of it.

According to researchers Haag et al. [...} Monitoring is a space where students can work at their own pace, as the number of hours available is not limited. In addition, monitoring tends to provide reception by monitors [...]. In this way, students experience an environment that provides freedom to question and perform practical activities. (2008, p.217)

Thus, the counselor acts autonomously in his process, thus enabling him to develop aspects in academic development during monitoring, obtaining an improvement in their social development.

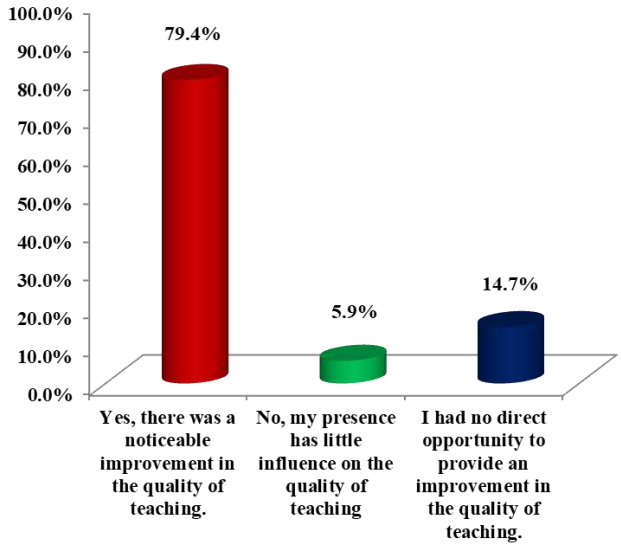
A possible aspect to identify the influence of monitoring is whether the respondents consider that their participation enabled an improvement in the quality of education offered. Most respondents answered positively,

https://dx.doi.org/10.22161/ijaers.69.27 *ISSN: 2349-6495(P) | 2456-1908(O)*

with 79.4% who have already completed the process answered “yes, there was a noticeable improvement in the quality of teaching”, 14.7% realized that “my presence had little influence on the quality of teaching”. And the 5.9% minority "had no direct opportunity to provide an improvement in teaching quality." We can better visualize this data exposed in Graph 7 below.

There was also the same interview related question above for students in progress with the monitoring, the answer was very satisfactory because 100% of the answers obtained answered that they noticed a noticeable improvement in the quality of teaching.

Graph 7 - Quality of Teaching



Source (The author, 2019)

Throughout this research we sought information about the academic evolution of the monitors who participated in the monitoring program, if they had produced anything scientific, such as expanded abstracts, articles, research or similar, since the implementation of research and extensions as part of the academic formation are of extreme necessity for the undergraduate student (MARTINS, 2007, p. 33).

As results were collected that 5.26% of respondents developed some line of research that totaled 2 people out of a total of 38 respondents, which shows that, currently, the program has no major influence on the scientific field, being partially unable generate the desire in the monitors to conduct research in the areas in which they are inserted.

3.4 Academic developments and monitoring program analysis

The academic monitoring program, like any other program, has undergone numerous changes and refinements since its inception, its changes from its methodology even to the monitors who develop this program. According to Santos and Lins (2007, p. 67),

The whole evolution of the program demonstrates that this was not always so: from a simple collaborator, the monitor became an active participant in the teaching-learning process, in which it plays a catalytic educational function in the dissemination of knowledge.

The central point of the monitoring program, as stated by Santos and Lins (2007) is the monitor, which performs the tasks and builds the knowledge of students outside the classroom, where they would not have a support, since the presence of a teacher out of the classroom and somehow unfeasible.

So nothing more plausible than analyzing how the monitor views this program and thinks it should undergo some modifications and improvements. For the undergraduate student to develop and improve their practice, there is an extreme need for guidance in the educational field (MARTINS, 2007), allowing for a better resourcefulness in the role to be performed.

Regarding the teacher guiding the course, throughout the survey, it was found that about 82.4% of respondents said that their teacher provided assistance, and remained asked to help throughout the monitoring program, but 17.6% said the reverse, who did not receive accessory from their teacher, which did not generate a good experience with that program.

Regarding overall satisfaction about the program, 100% said they would re-enroll in the Academic Monitoring Program selection process and 97.1% would recommend a program to a friend.

When asked if the program should undergo any modification or enhancement, 32.5% consider that the program does not need to undergo improvements, in contrast, 67.5% consider that the program should undergo improvements such as:

- Greater incentive for student participation in monitoring;
- Easier to book rooms;
- Greater availability of scholarships as an incentive, in addition to other benefits;
- Availability of new materials in the lab for students to practice, or even make available to students all materials to perform nursing practices;
- Better organization in the disclosure of vacancies and also in meeting deadlines for results;
- Prohibition of monitoring on the eve of evaluation, as it ends up overloading the monitor, making quality care impossible;
- A training for the monitors;

https://dx.doi.org/10.22161/ijaers.69.27 *ISSN: 2349-6495(P) | 2456-1908(O)*

• Increased teacher involvement with the monitor and greater concern for the teacher to expose information to the monitor.

• Greater dissemination of monitoring, because many students do not participate, not taking the tests because there is no necessary disclosure of the selection process.

• Enable online reporting without protocol at the office.

• Better clarification on the issue of earning additional hours even when there was no demand for monitoring by students.

Among these points listed above, there were some points with higher incidence, making it clear that there is a great need for offering a quality monitoring program.

The first and most mentioned was related to possible training before starting the activities of the monitoring program, because according to reports, it is very difficult for a student in the middle of his graduation to be able to teach a class with the necessary efficiency, according to Silva e Oliveira (2014), continuing education is extremely important, because it is a time where knowledge is expanded, leads to reflection, problem solving, learns and teaches, skills that when linked to the monitoring program can further improve your results.

After the training, it was found that better dissemination of the screening process of monitors and greater dialogue about the monitoring program is necessary, so that there are more monitors and students themselves may be more willing to participate in monitoring classes.

IV. CONCUSIONS

From this study, it can be evidenced that the importance of the Monitoring Program at the São Camilo University Center allowed the students included in the program a greater teaching practice, obtaining positive as well as negative responses, generally evaluating the majority of respondents, Regardless of who has already concluded how many were still in the process, most showed satisfaction in the process, as well as the expectations as to the relevance to their formation.

From the data collected throughout this research we can consider that the program has some deficiencies in its particularities, which constitute primarily the availability of information about the program, as well as the incentive for it; the lack of proper guidance to future monitors regarding the program structure and also obtaining as an emergency need the training of monitors before performing the function. Training in the areas of classroom conflicts, pedagogical didactic aspects to be experienced by the monitors, the principles of human rights and environmental education in a transversal way.

Finally, it can be seen that the research was stable, but with a smaller than expected sample by the existing population, making up the amount of 27% of the total found. So, even with this quantitative it was possible to establish all the parameters contained throughout this research.

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https://dx.doi.org/10.22161/ijaers.69.28 ISSN: 2349-6495(P) | 2456-1908(O)

Inclusive Education at the Federal Institute of Minas Gerais Campus Ouro Preto
Educação Inclusiva no Instituto Federal De Minas Gerais Campus Ouro Preto

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Abstract*— *The present paper tries to research the actual conditions of the teachers at the Federal Institute of Minas Gerais Campus Ouro Preto, to attend disabled students, proposing actions to allow the improve of the teaching-learning process. The used methodology was the descriptive nature with a qualitative focus through the application of a survey with the teachers. To the data analysis was used the categorization technique. The results show the need of progress to make a better inclusive education as well as professor capacitation. Due the results was proposed a set of actions to the improvement of the inclusive education.
***Keywords*— Teaching-Learning; Professional Education; Technical Course.**

RESUMO
O presente artigo busca pesquisar as atuais condições dos professores do Instituto Federal de Minas Gerais Campus Ouro Preto, para atendimento a alunos com necessidades educacionais especiais, propondo ações que possibilitem melhorias no processo de ensino-aprendizagem. A metodologia utilizada foi de natureza descritiva com enfoque qualitativo através da aplicação de um questionário junto aos professores. Para a análise dos dados usou-se a técnica de categorização. Os resultados obtidos mostraram a necessidade de uma implementação de melhorias para educação inclusiva, além de uma capacitação junto aos professores. Diante desses resultados foi proposto um conjunto de ações para melhoria da educação inclusiva.
***Palavras-chave:** Ensino-aprendizagem; Educação Profissional; Curso Técnico.*

I. INTRODUCTION

The present paper demonstrate the need to delineate action in the sense to implement a better custom care of disabled students regularly registered in the technical course.at the Federal Institute of Minas Gerais Campus Ouro Preto.

Since the promulgation of the Federal Constitution of 1988, it'sassure education as a right and duty of all and a responsibility of the Estate and the family with should be promoted and encouraged with a society collaboration, looking for a full development of the individual to be able to exercise citizenship.

Based in that document principles, should be guaranteed equally the access and permanece of the learners in the school and guaranteed a free and obrigatory basic education. Beyond this, it's expected specialized education for disabled people preferentially at the regular education.

Demonstrating the idea of education for all, in 1994 happens the Conference of Salamanca known as the propelling of the inclusive education. From then on became to surge other documents to guarantee the education for disabled people.

It's has been three decades since the Federal Constitution promulgation and two decades since the Conference of Salamanca but it was a shy progress in the sense of capacitation of the professionals to offer to disabled people condition to become citizen, quality in study and continuity in the schools as there was no investments in the professor formation.

https://dx.doi.org/10.22161/ijaers.69.28 *ISSN: 2349-6495(P) | 2456-1908(O)*

The development of the present study seek to research the actual condition of the teachers from the Federal Institute of Minas Gerais Campus Ouro Preto, to the attendance for disabled student, proposing action that will allow improvement in the process of teaching-learning.

II. METHODOLOGY

The research was done at the Federal Institute of Minas Gerais Campus Ouro Preto with the application of a semi structured interview to know the qualification of the teachers in inclusive education and they need front a handicapped student. Besides the questionnaire was made a bibliographical and documental search to gain information about the actual situation around this theme in the area of the institute.

The data analysis was based in the categorization according to Minayo (2010, p 71) he classify then: ''The categories are utilized to establish a classification. In that sense working with then means to agrupate elements, ideas or expression around a concept that is capable to cover all of this''.

CONCEPTUAL ASPECTS

Through the century, disabled people has been treated by society as incapable of manage their own life, and had no consideration of their rights, their abilities and capacity of learning, and for pure prejudice of the family they ended up being sent to a hospital where they have been submitted to cruel treatments methods.

Was in the second half of the XIX century, in parallel to public hospital implementation that the State also begin to take action in the area of mental diseases - treated at that time with rigorous isolation.

The studies of the doctor Franco da Rocha emerge something hopeful and different, trying to do not limited the care of a handicapped person by applying chemistry formulas or using some other drastic treatments.

Back then there was already a perception about the importance of education coming from the pedagogic field that tries to systematize a knowledge that could make these children subject of schooling.

> ''Hence the possible viability, since the hygienic habit formation, of feed of try to dress etc. necessary for the social interaction. They put in a dramatic way what is being established in the disable education: segregation versus a larger social practice integration.'' (JANNUZZI, 2004, p.38).

That segregationist politics prevail until a few years ago, and did not possibilitate the interaction with the different, creating a lack of knowledge in the inclusion-related questions of a person with a disability.

According to Mantoan (2005, p. 26): ''Our conviviality with disabled person in the regular school is recent and it still create a lot of apprehension between they''

The change of look, recently occurred is a dichotomy in a border zone between the acceptance and the respect to the differences of the ambient, approaching debate, and good rated proposing to the attendance and understanding about the differences, as pointed Lima (2006, p. 17) apud (GOMES, 2007, p. 19).

> ''The diversity is a human rule: human being are diverse in cultural experience, are singular in personality and also diverse in the world perception form. Human being present yet biological diversity. Some of this diversity provoc distinct nature impediment in the development process of the people (the commonly called as ''special needs people'')''.

The human diversity is the primary aspect to the understanding of inclusion, because it's a social process, human and singular of each individual.

The big mark in the inclusive education happens through the Salamanca Statement in 1994, in Spain with the help of the United Nations Educational, Scientific, and Cultural Organization (UNESCO).

In the history of the inclusive education, until then, there was no document that reverberates more in the world. The concept of ''education for all'' was formalized, and where pointed basic critics to the accessibility of disabled or with reduced capacity person. Can be said that here was well-established the inclusive education.

The inclusive education gain a important tool concerning to the social demand, educationals and governmental, the responsibility cannot be put only in the school, and the interaction of a disabled person in education and social environment is everyone's responsibility, above all, could be a way to remember the politics they duty over this members of the society.

https://dx.doi.org/10.22161/ijaers.69.28 *ISSN: 2349-6495(P) | 2456-1908(O)*

Since then, battle are being fought constantly for the social inception of disabled people in every social space. In a broader perception we can say that change the concept of citizen and introduce in the environment new social individual, a hierarchy of power breaks down where can imperate new possibilities of teaching-learning to special education.

The ''Estatuto da Criança e Adolescente (ECA)'' (Statute of children and adolescent), o ''Plano Nacional de Educação (PNE)'' (National plan of education), o ''Ministério da Educação (MEC)' (Education ministry)', the ''MinistérioPúblico Federal (MPF)'' (Public federal ministry), o ''Núcleo de Atividades de AltasHabilidades/Superdotação (NAAH/S)''(Activity nucleus of high ability/gifted), among others are important contributors in the specialized teaching formation. The fight of these members became to have the same objective which was the access and permanece in the basic education as much as in the superior education, guarantee the straightening of public school and the right for access and permanency of special need students.

This challenge is slowly taking steps and has been seeking through the construction of debates with various sectors of society, especially in the scholar ambient promoting a daily convive with the pair in the class of the regular teaching, not only in the school quotidian relationships, but also in varied social ambients.

Understand the inclusion is to dimension the approach for a integrative education. It's also dinamize and adapt the curriculum with peculiarity of the special needs student. In this sense it's important to know they history, conceptual aspects and show then to face the society and their problem as well as they acceptance process in the regular school.

The educational inclusion process must help and guarantee the right for equality and equity of opportunity. That doesn't mean aigual way to educate all, but a way to guarantee that everyone learn, guarding their singularity.

Considering the historical process the concepts changes, the teaching methodology and practice,the legislation, indicating progress concerning to pedagogic proposals. About that, Arantes (2006, p. 35) says:

> ''The planning and the implementation of educations politics to attend students with special needs requeer conceptual domain about scholar inclusion and about the resulting solicitation of his adoption as ethical-political principles, as well as the clear definition of the principal and directives inthe plan and elaborated programs, allowing the (re)definition of the papers at the special education and attendance locus of this students''

The inclusive education demand also a better professional capacity from the teacher and more diversity and extensive educative projects that can be adapt to distinct needs from all learners. Require a higher flexibility and educative diverse offer, in a way that all learners develop all the basic competence established in the scholar curriculum through differents and alternative proposal related to learning situations.

Suggest tooa expressive curriculum development for all, because the student inclusion is not limited to socialization but must guarantee meaningful lean for they with imply in structural change of the education system as one.

There's a lot of challenge front the transformation of the actual educational system in the inclusive educational system considering that all transformation will cause discomfort, fear, insecurity and require time to the structuration of the changes .

Above this there's another challenge that imposes for the efectivation of a new inclusive proposal in the Technical Course of Metallurgy at the Federal Institute of Minas Gerais Campus Ouro Preto, referring to the offer of a quality education that will guarantee a appropriate and custom service for the students with special educational needs, from the implementation of action that aim the elimination of the must number of barrier that prevent the full development of the learners with special needs, starting by the formation/capacitation of all teachers.

By legislation force the Federal Institute of Minas Gerais Campus Ouro Preto, has been receiving special need students in regular class without any preparation of the teacher yet so they can act with the specialities, differences and care that a disabled person demand in his development and learning process.

Teaching special need students demand from the learning mediator special abilities too, it's not possible for the teacher mediat the knowledge for a deaf person without knowing libras, to the blind without knowing braille, to short attention span or others mental disorder and disabilities without methodology and professional formation that will support in the sense of keeping the student attentive, interested, involved, comfortable and safe. But still not possible in a class of 30 to 40 students dedicate yourself exclusive to one rather than the others.

https://dx.doi.org/10.22161/ijaers.69.28 ISSN: 2349-6495(P) | 2456-1908(O)

The learning process require planning, behavior perception, education psychology, immediately and pontual intervention, sequence, diagnostic, continue evaluation, content redefinition, and in special cases some medical notion because all the learning must be done in a responsible way, effective and with quality to promote a citizen formation.

Insert a special need student in a regular class without the professionals education and capacitation is to sentence then to exclusion, one of the most cruel segregation form and for the teacher the impotence front the learning problems of the student.

Therefore the formation/capacitation of the teachers become emergent and imperative to the actuation with disabled person in the Technical Course of Metallurgy at the Federal Institute of Minas Gerais Campus Ouro Preto.

III. RESULTS AND DISCUSSION

The federal institutes understand the Technological education as the process of transmission and generation of scientific and technological knowledge that will allow the individual the domain of operative and intellectual activities, as a instrument to conquer the citizen and for the world of work needs attendance with the execution of creative labour in a critic and creative way with the productive sector.

The Technical Courses lack of actualization and improvement especially about the improvement of inclusive education for the compliance of the goals of the course and the regional peculiarity identity where the professional education institute is located.

Therefore reaffirmed the need of improvement implementation and the intensification of actions in the sense to contribute to a Inclusive Education formation for the professors that teach in the Technical Course at the Federal Institute of Minas Gerais Campus Ouro Preto.

From the research was realized through the application of a survey, collecting the necessary subsidy for the elaboration of a improvement implementation proposal in the attendance of the students with special educational needs in the Technical Course of Metallurgy ministered at the Federal Institute of Minas Gerais - Campus Ouro Preto, with the purpose of verifying the teachers conception about the need for a formation improvement in Inclusive Education in the Technical Courses providing us subsidy for a improvement proposal elaboration about Inclusive Education for the Technical Courses of the Federal Institute of Education, Science and Technology of Minas Gerais Campus Ouro Preto, was possible to develop in the quotidian scholar practice, together with the docents of the Technical Course through the application of the survey following a collected data analysis.

Was analyzed and evaluated all the information obtained from the questionnaire that was answered by the teacher from the technical courses in the sense to contextualize the actual reality of the inclusive education.

After the application of the questionnaire for the teachers, it was found some suggestions related to certain aspects from the inclusive education in the technical courses.

Therefore the most important informations was synthesized serving as subsidy and reference for the elaboration of the improvement elaboration proposal in the Inclusive Education and Teachers Formation in the Technical Course at the Federal Institute of Minas Gerais - Campus Ouro Preto.

Between some more pertinent and relevant aspects that was registered and taken in consideration in the elaboration of the inclusive education and teachers formation proposal for technical courses improvement can be highlighted:

- The research really show the improvement necessity for the inclusive education and teachers formation of the technical courses;
- The Professors affirmed to be necessarie a better capacitation as well as a initiative proposition that can contribute for improvement in the inclusive education of the technical courses;
- The teachers presented some suggestions of initiative of capacitation and actions for improvement of the Inclusive Education in the Technical Courses;

Finally, all the collected informations in the development of the research was taken in consideration and served as subsidy for the elaboration of a inclusive education improvement implementation proposal in the Technical Course at the Federal Institute of Minas Gerais - Campus Ouro Preto.

ACTION PROPOSAL FOR IMPROVEMENT IMPLEMENTATION FOR THE INCLUSIVE EDUCATION ATHE THE TECHNICAL COURSES MINISTRATE AT THE FEDERAL INSTITUTE OF MINAS GERAIS CAMPUS OURO PRETO

The Federal Institution of Minas Gerais Campus Ouro Preto needs a bigger society integration with the society stimulating the interaction between the governmental institution, non governmental institution and the productive sector through action that valorize the professional education and technological with enfasis in the inclusive education.

https://dx.doi.org/10.22161/ijaers.69.28 *ISSN: 2349-6495(P) | 2456-1908(O)*

Consequently in the sense of implementate improvements was realized the 1º Symposium about Inclusive Education in Ouro Preto.

This symposium aimed for integrate in a single event the actions of interaction with a local community and all involved in the Courses of the Institution and funding agencies allowing a bigger involvement with the Inclusive Education.

In this symposium was reaffirmed the proposal of the municipal representation creation at the city of Ouro Preto of the National Association of the Inclusive Educators that actuate directly with inclusive education in the health and society in general as the Federal Institution of Minas Gerais Campus Ouro Preto, mainly in a historically exclusionary city both in ambit of the accessibility for disabled people or with reduced mobility as well as for the ethnic-racial and socioeconomic questions (SIOP, 2019).

One of the points of the symposium was also the possibility to promote a integration of the school together with the community and also provide a ambient of contact between the students, servers and teachers with reference in Inclusive Education.

Besides the Symposium in Inclusive Education at Ouro Preto the event count with the realization of others concomitant events such as the Encounter of Inclusion Nucleus of Minas Gerais.

Another parallel event was the the National Association Encounter of Inclusive Educators from Brazil and the National Encounter of Inclusive Art-Education.

The event had as theme ‘’Health, education and diversity’’ counting with a organizer committee compound by professionals that study, research and work with minority, disabled people and social inclusion.

With the theme ‘’Health, education and diversity’’ the event provided dialog and survey of the questions that affect and contribute directly in the professional actuation, researches and Inclusive education scholars.

Thus, it was intended to promote the professional and intellectual development of the servers, leaner and professors with the intuit to better qualify then to act with special needs students.

In the realization of this 1º Symposium of Inclusive Education highlighted the following actions:

- Present the characteristics of the institution courses that search for a professionalized formation possibilitating the Inclusive Education;
- Possibilitate the encounter of the Inclusive Education nucleus representants;
- Promote interchange of information between organization and people that acts in the field of Inclusive Education;
- Offer to the participants lecture, conferences and short courses as a way to contribute for the development of individuals skills on the Inclusive Education;
- Promote the discussion of themes about Inclusive Education involving people and organization already inserted in the actual national and stadual scenery;
- Expose the informations of interest in the Inclusive Education area;
- Presentation by the participants of the Symposium through oral communication and banners presentation with informations related to Inclusive Education using videos, flyers and lectures;
- Dissemination assemblage of stands and boards for the institute education, organizations and people;
- Diffusion through videos, flyers, Inclusive Education leaflets;
- Realization of workshop with the following thematics:

- Specialized Educational Attendance;
- Professional education and learning;
- Education for the ethnical racial relationship;
- Education and Art;
- Education and Healthy;
- Education and Diversity;

As the main public of the symposium we had the participation of education professionals, educational managers, public managers, Inclusive Education Institutes and also for the participation of several students.

The intention of the event was to provide a opportunity for the change of ideas and fomentation of studies, researches and practices oriented for inclusion, starting a local event in the city of Ouro Preto, in Minas Gerais.

Therefore being subjects as Inclusive Education, Inclusive Nucleus, Professional Education, Professional Learning, Work and Income, Culture, Inclusive Education-Art and formation for a better specialized educational attendance, was some of the thematics that attended and will attend as conductors priority for the development and improvement of the Inclusive Education.

https://dx.doi.org/10.22161/ijaers.69.28 *ISSN: 2349-6495(P) | 2456-1908(O)*

With that, the improvement implementation proposal for Inclusive Education in the Federal Institution of Minas Gerais Campus - Ouro Preto technical courses, present a enormous diversity of actions, carefully elaborated, on behalf of a quality education each time better and in the defense of a integral formation of the citizen, where's intended though this proposal to attend the market demand of job and the society in general, where considered evidently the peculiarity of the technological development, and especially provide to the people that want their difference to be seen from a diversity perspective, and the society is diversified, and the human diversity contribute for a social improvement.

IV. CONCLUSION

The proposed actions aiming the implementation of improvement in the Inclusive Education at the Federal Institution of Minas Gerais Campus Ouro Preto, showed to be necessary and will contribute to guarantee to the teachers of the course better condition to act in the process of teaching learning, proporcinanting to the special needs students a qualification that will prepare then for the inception in the job market and attend to their individual and collective necessity in a independent and autonomous way, in a society that's constantly changing.

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https://dx.doi.org/10.22161/ijaers.69.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

Microsimulation in the Assessment of Vehicle and Pedestrian traffic in an Urban Network

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Abstract*— *Metropolitan cities have attracted and accumulated most of the world's population territorially. Concomitant to this, there are impacts generated by urban traffic, which directly affect social life and relationships, namely, educational, personal, commercial, among others. These impacts, by their very nature, involve multiple actors; multiactivities; complex relationships from and between people; different activities and infrastructures. In addition, the effects of rapid urbanization and the modernization and change of urban lifestyles have fostered new behaviors. Because of this, and the wide spectrum of variables, as well as the need to view and analyze scenarios, in this work we used microsimulation, as it offers possibilities to understand behaviors. Being proposed a model that describes the elements that make up the daily movement of vehicles and pedestrians in urban areas. This model is a modification of the traditional four-step approach, considering the behavior of each decision maker and other actors individually involved. The structure of the model consists of five steps: operational analysis; simulation structuring; data collect; measures of efficiency and acceptability. The research unit used was a metropolitan region with a high flow of pedestrians and vehicles, located in the state of Espírito Santo. The results showed that changes in tracing and use of restriction signals are alternatives that lead to the minimization of queues. The contributions of this work are not limited to scientific development, but also serve to compose the framework for decision making in the sector.

Keywords*— *Urban traffic; Pedestrian and vehicle flow; Integrated simulation platform; Transport policy; Sustainable urban mobility.

I. INTRODUCTION

Metropolitan cities throughout history have attracted and territorially accumulated most of the world's population. Thus, due to the impacts of the effects of rapid urbanization and the modernization and change of urban lifestyles, these cities start to demand solutions that help the organization of vehicle and pedestrian flows (HASSAN; LEE, 2015; TAN et al., 2016; ZHU et al., 2019).

According to Manaugh et al. (2015), urban transport planning not only aims to organize and balance vehicle and pedestrian flows, but also to promote the use of more efficient transportation systems. Ratifying this thought, Lee et al. (2017) emphasize that this planning must be continually reviewed over time, with the proposition of different mobility alternatives and land use scenarios.

The increasing demands related to the efficiency of urban traffic represent challenges to be solved in metropolitan areas (VERA, 2012). According to Piort et al. (2017), the high migration of people to urban centers has caused significant problems in managing the flow of people and vehicles in cities. With this high migration of people, congestion becomes one of the main factors responsible for urban quality of life, bringing stress, anxiety and tension to drivers and pedestrians (FELEZ et al., 2013).

On the other hand, urban travel flows are increasingly complex to understand (OSORIO; NANDURI, 2015). This view is corroborated by Jeihani et al. (2015), which highlights the high composition of variables from various actors. And, most of the time they need specific studies to understand their incidences and correlations.

The literature indicates that in case of studies of displacement flow involving vehicles and people, good technique suggests the use of microsimulation (COSTA et al., 2017; PASCUCCI et al., 2017; MANLEY; CHENG,

https://dx.doi.org/10.22161/ijaers.69.29 ISSN: 2349-6495(P) | 2456-1908(O)

2018). This is explained, according to Lee et al. (2017), because this technique allows investigating transport planning alternatives by modeling a problem situation, with subsequent scenario simulation. And, according to Zhu et al. (2019), their outputs serve two important purposes, namely to present a visualization of traffic flow conditions and to provide quantitative responses to differentiate service levels to be offered according to local conditions.

Thus, considering the reasons given, this work presents a proposal for a microsimulation model, which was used as a tool to contribute to the assessment of vehicle and pedestrian traffic in an urban network. To operate the model, a metropolitan region with a high flow of pedestrians and vehicles, located in the state of Espírito Santo, was used as a research unit.

II. THEORETICAL REFERENCE

Urban mobility takes into account the needs of a wide variety of road users, including various types of motor vehicles, as well as vulnerable users such as pedestrians and cyclists. This mobility decreases rapidly in much of the world. Factors affecting mobility levels and possibilities for improvement vary. Gakenheimer (1999) cites that rapid automobile growth, local demand conditions that far exceed the capacity of facilities, the incompatibility of urban structure with increased motorization, a stronger relationship between transportation and road use in developed cities and the lack of proper maintenance of the roads responsible to address the problem. Costa et al. (2017) adds that as the population of urban centers grows, there is a major challenge: adapting urban development and transport needs, seeking mechanisms to ensure the sustainable growth of local urban mobility. Constant traffic jams in large cities, caused by excessive use of individual transport, hamper urban mobility, resulting in damage to the population and the environment.

According to Pascucci et al. (2017), semaphore synchronization (Figure 1) is essential once idle time losses begin to prove meaningful, so taking drivers as a comparison with those on a traffic-free road takes longer to cross a section of road because of the presence of pedestrian crossings.

Osorio and Nanduri (2015) highlight that the delay time (or idle) is an adequate measure of traffic quality for drivers and pedestrians. These authors further add that energy efficiency is a growing concern of the transportation sector. From this, Osorio and Nanduri (2015) in their work using traffic simulation and vehicle performance assessment tools, concluded that these tools are vitally important in formulating traffic management strategies. Fact corroborated by Lacerda et al. (2012), who highlight a need for strategic management, based on elements that can simulate the ideal conditions of use.

According to Wen and Bai (2017), in the urban environment there are three important policies that must be considered to mitigate traffic volume and also reduce emissions from the urban traffic system. And, as a result, the reduction of energy consumption (renewable and non-renewable fuels), allowing, for example, to increase the average speed of vehicle flow.

Wen and Bai (2017) state that the first policy imposes restrictions on the registration number of vehicles; judged as a short-term policy. As the second policy is about controlling the number of private cars to interfere with traffic congestion, the third was to develop public transport.

Manley and Cheng (2018) suggest that this third policy is long term and has more stable effects. It also concludes that even the simplest models demonstrate how driver cognition significantly influences emerging responses in traffic flow.

Souza (2013) argues that the degree of spatial variation in traffic flow, within the context of fixed models in travel generation and distribution, demonstrates the importance of establishing strong fundamental representations of individual behavior and limited rationality involving the complex systems of travel. development of simulated flows. These simulations, and emerging evidence elsewhere, pose a significant challenge to the status of transport policy development and implementation.

Hu et al. (2015) state that a synchronization experiment showing the road mesh flow algorithm can, in fact, significantly improve the performance of vehicles within traffic under local congestion conditions, but the algorithm may lose efficiency over a traffic flow under traffic conditions. a global shelving.

https://dx.doi.org/10.22161/ijaers.69.29 ISSN: 2349-6495(P) | 2456-1908(O)

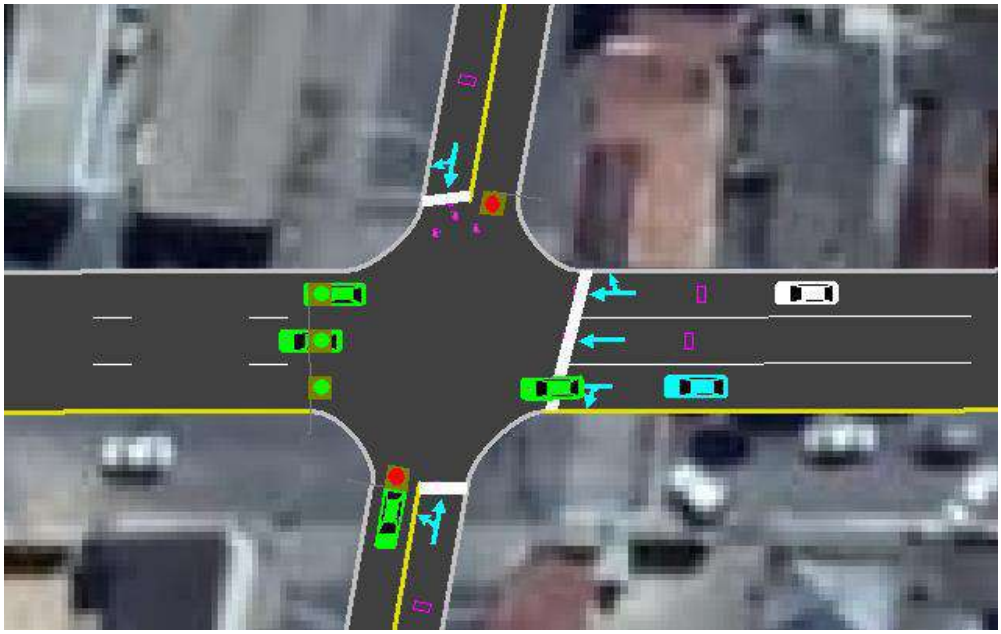

Fig.1: Exemplary semaphore synchronization modeling with stakeholder integration

Piort et al. (2017) demonstrated that it is possible to show that a standard conductor model can be used successfully for simulation purposes, providing reliable results. In addition, it can also indicate ways to develop more specific and useful methods for traffic control, such as signing drivers for appropriate lanes based on their behavioral profile.

Walraven et al. (2016) indicate the use of the simulation tool as a priority in urban flow studies, and is recommended for use by public authorities to gain more insight into how pedestrians and drivers interact with each other in crosswalks. In addition, pedestrian-vehicle encounters can be identified in advance by simulation, which provides information on potential safety issues prior to installation implementation.

From the perspective of Azam et al. (2019), in contrast to models used by other programs, a proposed model that considers each vehicle, including its physical behavior and dynamics, in terms of acceleration or braking maneuvers, and a driver behavior model, which provides braking. , accelerating, changing lanes, etc. maneuvers, depending on the parameters that define the driving style. These authors also point out that over simulations are usually included in a study of flow and urban traffic, to validate the developed model.

III. METHODOLOGICAL APPROACH

The methodological approach adopted in this paper followed the precepts of Walraven et al. (2016), considering that the diagnosis, analysis and planning of actions are used to adjust the elements that compose the traffic of vehicles and pedestrians in urban network. And from this, a use of microsimulation raise several enlightening information. According to Azam et al. (2019), understanding the nature of spatial variation behavior, in terms of time and stakeholder integeration, provides important insights that aid in the planning and management of urban traffic (people and vehicles).

Thus, this approach uses metrics that have the potential to be enlightening because they can be mapped to examine scenarios and alternatives for managing urban and pedestrian traffic flow. Thus, although it is routine in the literature to identify the location of possible traffic bottlenecks, on the other hand, little attention is given to identifying which elements suffer or cause delays. For this reason, the demand of the Origin-Destination (OD) matrix is considered in this paper as a temporal profile, which, according to Zhu et al. (2019) define the demand rate from each source zone to the destination zone within a given time interval.

Considering the postulates of Venkatesh et al. (2016), the data reconciliation in this work employed the concept of data triangulation, and, from that, adjusted procedures and techniques in order to converge results. This conciliation, according to these authors, provides a more intense understanding of the phenomenon studied. The methodological approach employed in this paper is composed of four steps (Figure 2), which are mutually dependent: Operational Analysis; Simulation Structuring; Data Collection and; Efficiency measures.

The first stage began with the identification of parameters considered relevant for the elaboration of the simulation model (Operational Analysis). This identification raised characteristics and particularities of

https://dx.doi.org/10.22161/ijaers.69.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

traffic that indicate factors, cultural, social, commercial, urban planning, and geometric design, which directly influence the occurrence of congestion and overuse of the existing road network (FELEZ et al., 2013). Such information is that, according to Ragab et al. (2016), reveal to us the number and width of roads, number and location of parking lots.

Thus, considering the data collected in the Operational Analysis, the Simulation Structuring (second step) was performed. This step was started by obtaining a georeferenced map, which was used to characterize the studied roads and intersections. And subsequently selected the most critical points for analysis. These points were selected from the critical consideration of use, as described by Hu et al. (2015). As research unit was used the metropolitan region of downtown São Mateus (Espírito Santo / Brazil), which has a high flow of pedestrians and vehicles, and congestion of stochastic origin. Having from P1 to P7 853.14 m meters and were rounded to 860.00 m (use of integers) meters when using the software. To operate the simulation model, Synchro version 10 - demo software and the assumptions and methodologies established by the Highway Capacity Manual (HCM-2010) were used.

3.1 DATA COLLECT

Tan et al. (2016) highlights as the first step to ensure the success of the simulation and the efficiency of its elaboration are the data collection and analysis steps, including: studies in the area of urban planning and transportation, counts and total traffic volume analysis, pedestrian movement data through filming, interviews with transportation authorities, contour maps, search for the maximum speed established on each lane and their reports. The purpose of the video observation was to obtain useful information on the movement and behavior of road users. Such collection was made in 7 crossings considered with a high traffic flow. Thus we can draw conclusions on the most critical area of the studied region. The video recording technique required certain additional features, such as the location of the cameras, so that the visual fields would allow a full understanding of traffic behavior at the intersection and ensure that they were not affected by any interference.

Traffic data determination, including total volume, accounts for the number of vehicles, pedestrians and cyclists during peak hours. This data collection and analysis will be the basis of all assumptions in the simulation. Using the collected data and mapping of the area in question, we will be able to establish optimal simulation and synchronization of vehicle and pedestrian flow in downtown São Mateus, allowing us to establish the optimal cycle time and color intervals. Green, yellow and red. The number of vehicles and pedestrians could be determined from an interval of one (1) hour between the hours of 07:00 am to 09:30 am, 11:00 am to 13:00 pm and 16:30 pm to 17:40 pm, by manual counting, and through the traffic survey application, which served as an aid for reliable counting and accurate baliser of the shoot.

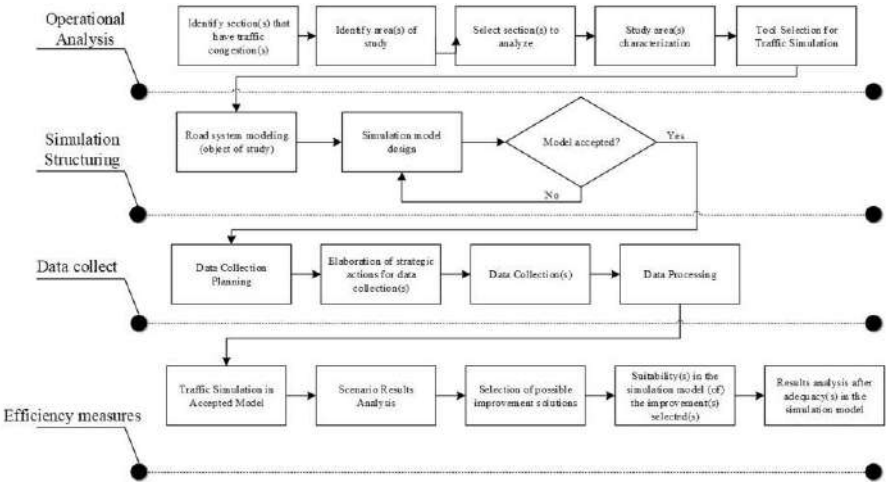

Fig. 2: Síntese da abordagem metodológica

3.2 EFFICIENCY MEASURES

The methodology considers the access to the intersections individually and the set of vehicles and pedestrians that travel through it. Soliman et al. (2016) tells us that Synchro is based on the most critical 15 minutes of the selected simulation time. One of the relevant steps of this research corresponds to data collection; for which, in order to improve the quality of

https://dx.doi.org/10.22161/ijaers.69.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

records and enable verification where necessary, footage was used. These procedures were described later. The following equation 1 was considered to find the ideal yellow time in the studied crossings:

$$y = t + \frac{v}{2a + 2Gg} + \frac{w + L}{v} \quad (1)$$

Being:

y = the interval time in yellow (sec);

t = driver perception time (1 sec);

v = vehicle approach speed (ft/sec);

a = desaceleração media do motorista 10ft/seg²;

G = degree of approximation (considered 1);

g = acceleration of gravity. 32 ft / sec²;

w = intercession length (ft);

L = vehicle length (15ft on average).

To calculate the total red color time, the following equation (Eq. 2) was used:

$$r = \frac{P + L}{v} \quad (2)$$

Being:

r = total red color time;

L = vehicle length (15ft on average);

P = intersection length (ft). Measured from the nearest to the farthest stop line of the conflicting crosswalk;

v = vehicle speed when passing the intersection.

Thus, after the optimization generated by the software, we were able to generate the ideal timing for each intersection.

IV. RESULTS

It can be noted that at peak times, the traffic of St. Matthew is considerably saturated, making the situation increasingly alarming. In the moments of great tourist arrival, the ideal signage is practically unfeasible, making the region stressful and difficult for both pedestrians, who end up taking risks on out-of-lane crossings and for drivers who often wait for more than one traffic light cycle before they can make their crossings (Figure 3).

With the simulation performed we were able to identify patterns in traffic flow that increase the risk of collision between vehicle and pedestrian, allowing the design of solutions to accommodate these high risk situations. The identified criteria are evaluated to understand their possible direct and / or indirect consequences on saturated congestion. From this, a detailed measurement was performed for each intersection, allowing to regulate the average volume at intersections, considering the types of vehicles, such as possible pedestrians that interfere with the flow (Tables 1 and 2).

Fig 3: Mensuração volumétrica em momentos de pico em São Mateus

Tab 1: Horizontal semaphore synchronization

	Horizontal	Sync in seconds (sec)		
Critical point	**Intersection Location**	**Green**	**Yellow**	**Red**
1	Av. João XXIII e Av. Dr Raimundo Guilherme Sobrinho	22	4	18
2	Av. João XXIII e Rua Manoel Andrade	30	3	18
3	Rua Anchieta e Rua João Bento Silvares	28	4	19
4	Rua Dr. Arlindo Sodré e Av. Jones dos Santos Neves	25	4	22
5	Av. José Tozzi e Dr. Raimundo Guilherme Sobrinho	25	4	22
6	Av José Tozzi e Rua Manoel Andrade	27	3	19
7	Av. José Tozzi e Av. Jones dos Santos Neves	23	4	23

https://dx.doi.org/10.22161/ijaers.69.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

Tab 2: Vertical semaphore synchronization

	Vertical	Sync in seconds (sec)		
Critical point	**Intersection Location**	**Green**	**Yellow**	**Red**
1	Av. João XXIII e Av. Dr Raimundo Guilherme Sobrinho	12	4	28
2	Av. João XXIII e Rua Manoel Andrade	14	3	34
3	Rua Anchieta e Rua João Bento Silvares	18	4	33
4	Rua Dr. Arlindo Sodré e Av. Jones dos Santos Neves	16	4	31
5	Av. José Tozzi e Dr. Raimundo Guilherme Sobrinho	16	4	31
6	Av José Tozzi e Rua Manoel Andrade	14	3	32
7	Av. José Tozzi e Av. Jones dos Santos Neves	17	4	29

Information regarding traffic lights, such as their cycle length, green, yellow and red light time and how long they are running intermittently, was also observed. According to the literature (DESSBESELL et al., 2015), they need monitoring and constant reformulation of simulations. In order to contribute to a better urban mobility for all users.

From the simulation performed, after a careful analysis of the traffic data generated, the data were added to a spreadsheet, point to point and specifying the time of each of the possible colors. Thus, the appropriate timing, according to the software studied, is shown first, point by point, the times related to traffic lights horizontally in Table 1. Then, in Table 2, we show the timing of the points positioned vertically.

We also observed that the maximum speed reached by the drivers was 32.4 km / h (range within the maximum allowed). We can consider the maximum waiting time for pedestrian crossing to be low, being 34 sec. Since in the current scenario the average red time is 35 sec duration. We must take into account that the journey made by the pedestrian is hardly too long (WEI, 2015), so the maximum waiting time at each traffic light is an important factor in the concept of pedestrian transition within the Mateense economic pole.

And an average speed of 21.6 km / h within the studied areas. Analyzing an environment with a very intense flow, it is considered a satisfactory speed in the current context, revealing favorable the work done. This way, drivers will be able to pass these overcrowded places more easily and follow the journey with less stress through less crowded places, thus leading to more safety for pedestrians.

IV. CONCLUSION

This work is relevant not only because it achieves its main objective of making the flow of vehicles and pedestrians more efficient in urban centers by using traffic light simulation to coordinate and improve the performance of traffic management policies. As well as being a contribution in terms of tools to public managers and companies in the sector. In the results presented, it was possible to verify the reduction of travel time and congestion and, consequently, a shorter waiting time among those involved, thus reducing the stress and discomfort of the occasion.

This effect affects the social spheres at the same time, providing a better quality of life for the driver and shorter exposure to traffic stress; economically, by allowing the best time spent to be invested productively or reducing the cost of activities involving vehicle displacement.

One of the main problems encountered during the study was the lack of capacity of downtown São Mateus to withstand the intense and voluminous flow at peak times and seasons, given a city that is watered with tourism and strong variations during certain times of the year. (city and summer party). Thus, our simulation proposed the model not necessarily the ideal model, but rather the model where in both parts, vehicles and pedestrians, would suffer the least loss of time during these moments.

It is noteworthy that other forms of traffic control should be studied, such as alternative routes and stimuli to change peak hours at certain times.

ACKNOWLEDGEMENTS

We thank the Operations Research Laboratory, Logistics and Transport (POLT) of the Federal University of Espírito Santo (UFES)/ University Center North of the Espírito Santo (CEUNES) by the academic and technical support in the design and development of this work.

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https://dx.doi.org/10.22161/ijaers.69.30 *ISSN: 2349-6495(P) | 2456-1908(O)*

Development of a System for Monitoring and Control a Resin Drying Oven using IoT

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Abstract**—** *This article presents the construction of a prototype of internet of things application to monitoring and remote control of a resin drying oven to electric restored engines, using the internet as the main means of data transfer and a free server, the complete system consists of a special board to get the temperature data from the drying oven, a liquid crystal display, a data viewing environment to provides the data access and the control from any device inside of local network and the central microcontroller ESP8266 with native Wireless Fidelity (Wi-Fi), firmware upgrades can be downloaded through Internet Protocol (IP) address without the need of traditional communication cables, the system was developed do get in the industry 4.0, applying a lightweight protocol, the internet to data transmission, and a low cost microcontroller.*
Keywords**— Internet of Things, ESP8266, industry 4.0.**

I. INTRODUCTION

Radio Frequency Identification (RFID) was the first technology created using the concepts of Internet of Things (IoT), it appeared in 1940 and was soon applied to the transponders of second World War (WWII) aircrafts [8]. The idea of connecting objects to a network and making them smart has triggered the development of various techniques and protocols for using smart sensors attached to microcontrolled systems. IoT brings the ability to remotely control and read data using lightweight communication protocols and low bandwidth demand.

Some of home appliances and electronics are controlled by embedded systems where has a main controller with a work routine described in a program, and recorded within their memory, however, to be able to connect to internet using the Wi-Fi network, the microchips should be adapted.

The programming difficulties of microcontrollers are directly linked to their manufacturing architecture and the types of peripherals available [1]. Technology developments have enhanced the functionality of programmable microchips, making them adaptable, opening a range of connectivity options including wireless networking.

Real-time monitoring and remote activation of a resin drying oven of induction motors is a simple example of IoT application with embedded circuits, as it is low cost and highly flexible, allow the deployment of two main features, intelligent communication, and data monitoring from anywhere in the world using common platforms such as mobile phones, tablets and computers.

II. THEORETICAL REFERENCE

The industrial evolution started in England around 1780 and was called as the first industrial revolution characterized as the beginning of the insertion of machines on industrial productions. It did not take much technology to start this process of revolution, and the inventions of that time were very modest [5]. Moreover, inventors were limited in both knowledge and resources. This beginning has triggered many changes in the working class and economy, starting the new professions where factories began to produce repeated patterns.

All other areas link to the transportation process of goods had to evolve to supply the demands of production mechanization, the need for raw materials for large manufacturing companies led to the growth of worker

https://dx.doi.org/10.22161/ijaers.69.30 ISSN: 2349-6495(P) | 2456-1908(O)

exploitation. This evolution extended until it reached several countries in Europe and others countries.

The second industrial revolution presented several driving factors, such as electricity, media, and the means of transportation, and the need of specializations in various areas of knowledge. Between 1820 and 1850, for example, the British movement created some institutions for social education for the class working to meet the needs of the industry [5].

The third industrial revolution was characterized by the advance of electronics and computer systems, due to the development of knowledge in the areas of mechanics, computing and electrical. One of these areas was linked to industrial networks, which then emerged to standardize the forms of data traffic between devices from different manufacturers that formed an integrated and automated system.

Automation has developed with new technologies that have emerged and continue to emerge to assist industrial solutions, the industrial automation is not only to replace human labor, but also to brings production improvements, cost reduction and space optimization [9].

Since the emergence of programmable logic controllers (PLCs) in the 1960s, it has been used for the most diverse process controls, both in large industries and in small businesses. Thus, the graphic interfaces began to provide man a great control of machines and production processes through computers, nowadays the Human Machine Interfaces (HMIs) are almost indispensable in the industrial environment, in order to assist the system [9].

1.1 Embedded circuits

Embedded circuits are microprocessed electronic systems which work from a routine described by a program burned inside its memory, have a specific function that most of the time cannot be changed [1]. These are present in people's daily lives, characterized as a small dedicated computer and can have a high level of complexity.

As there are several microcontroller manufacturers, their hardware differences differ significantly in applications and may influence the time to develop a project, and to reduce these impacts, several standardized platforms have emerged with greater ease of programming and broad adaptability [13].

Several microcontrollers today are classified as low-consumption devices, which makes their application very cheap and affordable in various products, examples are toasters, ovens, electronic locks and alarm systems [8].

1.2 Industry 4.0

The Industry 4.0 is a new period in the process of industrial revolution, gathering the latest and most accessible technologies and applying in manufacturing systems, the result is an intelligent factory that is able to predict failures, and control their processes, via sensors or actuators inside of a data sharing network.

Industry 4.0 is a concept that become possible through constantly developing technologies for computing and engineering, such as: IoT, Big Data and Cyber Security [12].

One result from all of this industrial evolution was the rapid development of related areas, such as electrical engineering, IT and industrial automation. The automation will directly reduce corporate staff in order to robotization process, but prepared professionals for new trends will be the key of the deployment of smart industries.

1.3 Internet of things

The internet of things has become popular due to electronic systems evolution, the current internet will also become the means of connecting machines, which will assure the remote control and reading of devices. Since the popularization of the internet, around of twenty years ago, it was already thought to control things over the internet, so the concept of internet of things is not something new [8].

Wi-Fi networks are a differential for the use of this technology, without the large amount of wires, allowing the interconnection of devices in the same network. There are a few different ways to connect a device to the internet, and this is directly linked to the amount of data you want to transmit, the size of network coverage, and where the devices to be monitored are positioned [6].

Although human interaction in IoT systems is important, there are systems that can work autonomously using Machine to Machine (M2M) interactions, where machines exchange data with each other and make their own decisions [11].

The M2M aims to integrate physically and virtually objects of different types and manufacturers that are geographically distributed in a particular environment, they must communicate in harmony without requiring human intervention [3].

1.4 MQTT Protocol

The MQTT protocol is a data transmission standard designed exclusively to be lightweight and to work on networks with unstable connections. It uses the Machine to Machine (M2M) concept to connect smart devices to a network [4].

Despite the popularity of the MQTT protocol for IoT applications, it is also being used for other applications because it has security and guarantee of data transmission and is able to manage it correctly [4].

https://dx.doi.org/10.22161/ijaers.69.30 ISSN: 2349-6495(P) | 2456-1908(O)

III. MATERIALS AND METHODS

The study adopted the descriptive research method based on theories contained in books and articles, with the purpose of applied research where knowledge and techniques can be effectively used in real life. It does not use statistical methods or techniques, but uses the researcher as the main instrument for data collection, maintaining direct contact with the environment and the object of study [10].

Automation in the production processes of Brazilian industries has grown rapidly, with new technologies the industrial processes tend to be faster and with less cost with human labor and the employment processes, the connectivity and ease of supervision of production lines offers greater control, however many industrial equipment is old and requires high investment for high technology adaptations.

It is of great importance the development of embedded systems able to interact with industrial environments without much physical changes, and transmitting for production control purposes, data, that does not expose industry secrets and that can self-diagnose against errors, that may directly affect the operation of equipment, this type of predictive fault detection in addition to extending machine life provides planned actions for replacements and repairs.

3.1 Study area

The IoT embedded circuit installation location was in a company of technical assistance and maintenance of motors and generators of low and medium voltage, small motors like submerged pumps and manufacture of electric cabinets, located in the city of Manaus in the Amazonas, the firm has team for emergency to solve problems in other cities, with major partners such as mining and hydroelectric.

This company has a drying oven which it uses to dry the WEG manufacturer's lackterm resin, used in motors for insulation and coating of coils. Electro insulating resins have great chemical resistance being applied in various electrical powers and temperatures, having thermal class H-180 ºC, used in motors, high and low voltage generator sets and all hermetic motor powers [14].

The resin drying oven must reach a temperature between 130 and 150 ºC for a time ranging from 6 to 8 hours, and the constant monitoring of temperature and the time is necessary to ensure quality in the services provided, but to see the temperature variable and the activation and deactivation of the heating resistors someone must be in the workplace to act.

Aiming comfort and quality in the resin drying process, a high level computational but low cost embedded circuit has been developed to remotely monitor and control via Wi-Fi. It can be displayed in real time on a user interface stored on a local server, drying oven temperature and can also be turned on and off at any time as long as it has connectivity to the Internet and on the same local network.

3.2 Chosen electronic components

The NodeMCU Fig.1 manufactured by the Chinese company Espressif Systems was chosen to be the central microcontroller of the system, is versatile and low cost, having the advantage of Wi-Fi connectivity.

This chip can operate at processing speeds of 80 or 160 MHz, having 16 input or output pins, the wireless network is compatible with the 80.11 / b / g / n standard [2].

The NodeMCU module adds in one module the ESP8266 chip, with direct Universal Serial bus (USB) connection via converter, voltage regulator, resistors and capacitors, which will facilitate the prototyping of the control board. Some ESP8266 Pins can function as SPI, UART, I²C, I²S communication interfaces or ADC [2].

Fig.1: NodeMcu

To measure the temperature using a type K thermocouple, the module chosen was the MAX6675 Fig.2, which has the ability to convert an electrical reading ranging from 0 to 1024 °C, in a digital output with 12-bit resolution and is able to transmit the data through a Serial Peripheral Interface (SPI) communication [7].

Fig.2: MAX6675

To make it easier to see local network connection information, a 20-character, 4-line Liquid Crystal Display (LCD) Fig.3 was added to the project to show connection status, Host and IP. For NodeMcu communication with Human Machine Interface (HMI) without using many pins

https://dx.doi.org/10.22161/ijaers.69.30 *ISSN: 2349-6495(P) | 2456-1908(O)*

the ESP8266 has the Inter-Integrated Circuit (I²C) communication, using only 2 pins of the chip and can send data to LCD using PCF8574 integrated circuit as adapter.

Fig.3: LCD 2004 I2C

To control much larger digital outputs and switching elements, 12 Volts relays with the ULN2803 chip will be used as a driver to reduce the number of components and turn easier the routing of printed circuit board paths. The relays can be driven at low current, around 1.35mA using ULN2803 being able to drive loads greater than direct microcontroller actuation.

To develop the printed circuit board was used the Proteus Design Suite program developed by the company Labcenter Eletronics Ltda, and on this platform it was also possible to simulate parts of the electronic circuit and from there create the prototype of the board that holds all the components mentioned above Fig.4.

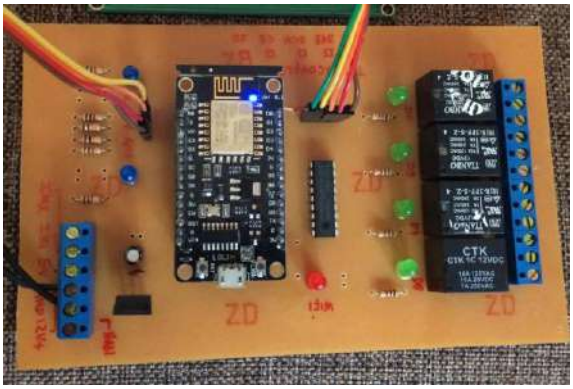

Fig.4: Main Board

3.3 Communication architecture

Communication between the devices uses the architecture of Fig.5, where you can identify the devices and the free MQTT server called broker. The device that sends data to broker is called publisher MQTT, while the device that receives data from server is called Subscriber MQTT [8].

For MQTT communication in which both clients must be connected to broker server, messages are filtered and oriented to their proper destination through a specific topic [11]. To get data published by a sensor on a "Drying/Temp" topic, the subscriber must to request the data using the same topic, each device connected to server must have its own identifying name to avoid conflicts.

The block diagram shows in a simplified way how the whole drying oven monitoring system is configured, where the arrows symbolize the communication and commands between the devices.

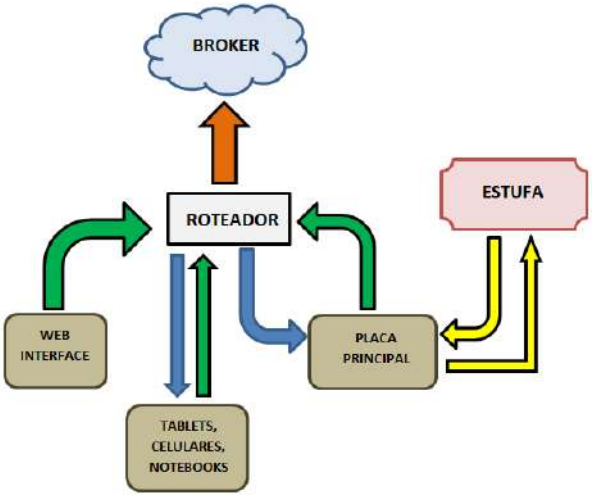

Fig.5: Block diagram of system

3.4 Test of sending and receiving data

CloudMQTT was the free broker chosen for the system because it has secure access to data and can be accessed via bidirectional communication (WebSockets), after creating a username and password on the cloudmqtt.com site, was created the system topics.

Table 1 below summarizes the topics created for the system and their role in the process.

Table.1: Topics from the system

Topic	Function
On/Drying/status	Read the physical Status of Drying oven, if is 'on' or 'off'.
On/Drying	Read or write the word 'ON' or 'OFF' to turn on the dry Oven
Drying/Temp	To read or write the temperature value
On/Light	Turn on the light

In order to visualize and send the data in real time, a user interface Fig.7 was developed with direct connection to the broker server through WebSockets, thus, any device connected to the local network can access using a web browser requesting the page by the server static IP address **192.168.0.9**, so there are two devices, where one of them store the monitoring page and the other device is attached to the printed circuit board, that is in the field with the monitored process.

https://dx.doi.org/10.22161/ijaers.69.30 *ISSN: 2349-6495(P) | 2456-1908(O)*

Fig.7: User interface

The temperature value is published by the motherboard through the local network and the Internet and is updated every second, the motherboard stays connected to the broker since power up and is able to reconnect if there is any access failure.

Another way to access broker data is to use the MQTT Dash App Fig.8 available on the play store for android phones.

Fig.8: MQTT Dash monitoring

IV. CONCLUSION

The development of an embedded system to monitoring a drying oven with low cost, was a way to integrate old systems through the internet of things, according to the tests performed, the ESP8266 was efficient in data transmission over Wi-Fi network. This system was installed inside of an electrical cabinet aside of a real drying oven and the results were good and the main board is working with high robustness.

This kind of prototype can be used in several application, whether industrial environment or not, to monitoring or control any process, the ability of the ESP8266 to connect to the internet over the Wi-Fi network is a big advantage over other microcontrollers, in addition the firmware can be updated using the way over the air (OTA), that is a remotely way to transfer the firmware without traditional cables, and the prototype can be expanded according to the need of the process.

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https://dx.doi.org/10.22161/ijaers.69.31 *ISSN: 2349-6495(P) | 2456-1908(O)*

Environmental Criminal Responsibility and Applicability of Brazilian Constitutional Principles

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Abstract**—** *The environment constitutes a group right, endowed with an indivisible object without a determined ownership and interconnected by certain circumstances indeed. Considering its relevance and the need to ensure its preservation and safeguard the environment for present and future generations, the Magna Carta of 1988 instituted in its text the protection of the environment, by means of axiological precepts, and the infraconstitutional legal framework established stricter tuitions, including in the penal. Through bibliographic research, with the analysis of national and international scientific articles, and research of Brazilian legislation, this work was carried out in order to verify the effectiveness of environmental laws. Thus, the objective of the research is to analyze the applicability of principles, highlighting the principles of prevention in the environmental sphere, as well as the form of accountability of the causers/polluters for the damage practiced. The case study took into account the environmental damage related to the Mariana Dam, the Ultra cargo Fire and the Brumadinho Dam.*

Keywords**— Environmental damage, prevention, Criminal Responsibility.**

I. INTRODUCTION

Because of the major changes that have occurred over the last century, such as economic growth and technological development, it is noted that the environment has become a path to prosperity and human evolution. It occurs that the environment, as a sector of the economy, ends up being under the control of those possessing the greatest economic power. Supervision f the way in which environmental laws are exploited and applied is ultimately impaired in many cases.

It is essential to address the provisions of article 225 of the Magna Carta (Brazil, 1998), where it provides that the environment is a right and a duty of all, should be preserved not only for the present, but also for future generations.

In this respect, it is necessary to emphasize the relevance of knowing that the environment constitutes a diffuse right, present as a group right, endowed with an indivisible object, without a certain ownership and intertwined by certain circumstances in fact (FIORILLO, 2017,p. 40).

In the face of this, the Federal Brazilian Constitution of 1988 instituted in its constitutional text the existence of a good that have no characteristics of public object or private, from the institute of ownership and property and thus creating a structuring for the protection of environmental values. As a result, the postulated Carta Magna instituted in the legal order a form of application of the Law from axiological precepts, endowed with an impeditive capacity, which permeate the legal framework, the principles.

https://dx.doi.org/10.22161/ijaers.69.32 *ISSN: 2349-6495(P) | 2456-1908(O)*

With regard to the principles focused on environmental protection, the principle of prevention and the principle of the polluter pays stand out. In this sense, it seeks to make a beginner analysis of three environmental disasters occurring in the Brazilian territory: the Mariana Dam, the Ultracargo Fire and the Brumadinho Dam. Moreover, when analyzing these cases, it should be taken into account that certain conducts generate social repercussions – in view of the role of the media-, resulting in the need for a more severe intervention by the State,that is, in the criminal liability of the causer agent in a manner proportional to the.

Therefore, the considerations regarding the cases presented are sought to verify what has been infringed for the occurrence of these disasters, as well as the reasons that led to non-compliance with environmental securities regulations. Therefore, it seeks to analyse whether these disasters occur are environmental crimes, which are passive environmental criminal responsibility.

II. METHODOLOGY

The methodology used in this article will be exploratory research, wich Will be based on literary, specialized works, besides the use of scientific articles and research that substantiated the theme.

2.1 Publication Analysis

Based on the data obtained by the Portal BDTD (Biblioteca Digital Brasileira de Teses e Dissertações), it is denotes that in a period of 10 (ten) years, the amount of dissertations related to the theme of environmental law were 3135 (three thousand one hundred thirty five). In the table 1, it is possible to verify the institutions that published the dissertations in the period from 2009 to 2019, as well as the number of dissertations of each institution.

Among the data acquired, it should be noted that the University of Brasilia (UNB) was the one that had the highest number of publications. However, another significant number was the one shown in other institutions, which included the number of total publications of the institutions which had a publication below 40 (forty) dissertations.

Table.1: Master´s Defenses on environmental law

Instituição	Período de publicação (2009 a 2019)	Quantidade	%
UNB	2009 a 2019	1224	39,04%
UCS	2009 a 2019	163	5,19%
PUC-SP	2009 a 2019	123	3,92%
UFSC	2009 a 2019	110	3,50%
USP	2009 a 2019	90	2,87%
UFPA	2009 a 2019	86	2,74%
UNISANTOS	2009 a 2019	86	2,74%
UFVJM	2009 a 2019	75	2,39%
UFC	2009 a 2019	73	2,32%
UFRRJ	2009 a 2019	63	2%
UNESP	2009 a 2019	51	1,62%
UFG	2009 a 2019	48	1,53%
PUC-GO	2009 a 2019	46	1,46%
PUC-RS	2009 a 2019	44	1,40%
UFRGS	2009 a 2019	43	1,37%
UFBA	2009 a 2019	42	1,33%
UFV	2009 a 2019	40	1,27%
* outras instituições	2009 a 2019	728	23,22%
Total	2009 a 2019	3.135	100%

*institutions with numbers of publications below 40 dissertations
Source: Organized by the authors.

https://dx.doi.org/10.22161/ijaers.69.31 *ISSN: 2349-6495(P) | 2456-1908(O)*

In the table 2, shows the number of dissertations that have addressed the theme of environmental criminal responsibility. The analyzed data correspond to the same period from 2009 to 2019. In this respect, there is a reduction in the number of publications addressing criminal accountability under environmental Law.

Among the instituions presented in the previous table, the one that obtained the highest number of published master defenses was Santos University Catholic (UNISANTOS), with 5 (five) publications. Moreover, when analyzing the number of publications, it appears that a small number on research related to environmental responsibility. Of the 3135(three thousand, one hundred and thirty-five) dissertations, only 26 (twenty-six), that is, only 0.82% entered the theme of criminal liability.

TABLE 2: Master´s defenses referring to environmental criminal accountability

Instituição	Quantidade	%
FDV	1	3,84%
PUC-GO	3	11,53%
PUC-RS	2	7,69%
PUC-SP	3	11,53%
UCS	3	11,53%
UFBA	1	3,84%
UFCG	1	3,84%
UFOP	1	3,84%
UFSC	1	3,84%
UFTM	1	3,84%
UNICAMP	1	3,84%
UNISANTOS	5	19,23%
USP	3	11,53%
Total	26	100%

Source: Organized by the authors.

It is also possible to highlight that, by filtering the data, now related to the cases under study, a dam rupture in Mariana/MG and Brumadinho/MG, as well as the fire that occurred in the Port of Santos/SP (Ultracargo), a smaller percentage of dissertations arises. According to table 3 only three dissertations were found that addresses tow of the cases under sutdy.

Table 3: Master´s defenses based on the cases under study

Instituição	Ano de Publicação	Caso citado	Quantidade
UCS	2019	Mariana/MG	1
UNESP	2018	Ultracargo	1
UNESP	2017	Ultracargo	1

Source: Organized by the authors.

Another relevant data is the one acquired on the Periodicals Capes MEC website. In a period of 4 (four) (2015 to 2019) only 19 (nineteen) scientific papers, written in the Portuguese language, that dealt with environmental criminal liability were found.

The respective analyzes demonstrate the lack of initiative on the part of Brazilian researchers to analyze

https://dx.doi.org/10.22161/ijaers.69.32 *ISSN: 2349-6495(P) | 2456-1908(O)*

the issue of environmental criminal liability further, as well as to analyze the environmental damage under study, from a scientific legal viewpoint.

III. RESULTS AND DISCUSSIONS

When talking about environmental disasters, it is of significant relevance to remember the incident that occurred in November 2015. Located in the municipality of Mariana/MG, the Fundão tailings dam broke downs, characterizing itself as the largest environmental disaster faced by Brazil. The iron ore tailings released by the rupture, as well as approximately 40 (forty) million cubic meters (G1, 2019) of mud, reached communities, residents, tributaries of the region and the Rio Doce, covering 663 (six hundred, sixty three) kilometers to find the sea, in Espirito Santo(CAETANO, 2019).

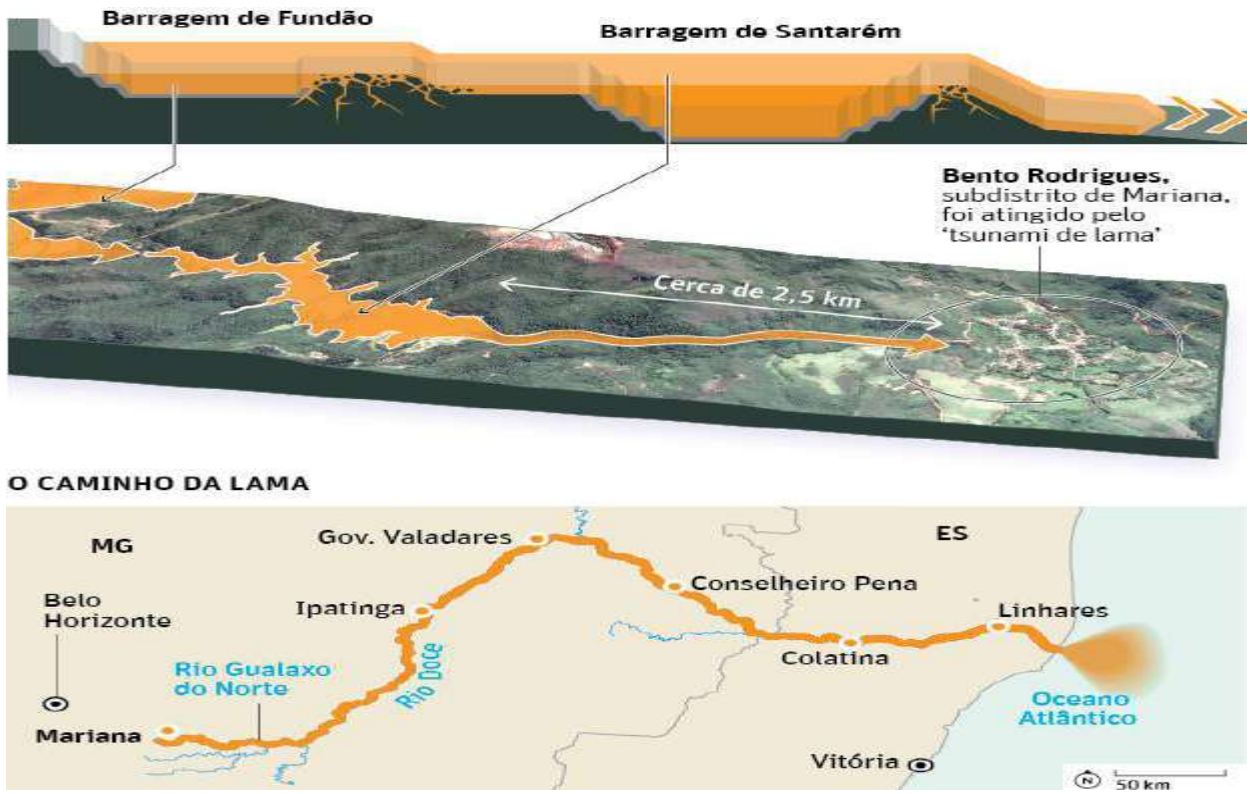

Fig. 1: Mud path in Mariana/MG

Source: Figure extracted from the UOL website, report The Tragedy(2016).

As a result of the disaster, there were material and socioeconomic losses. The district of Bento Rodrigues was devastated after the fact, homeless several people and with little availability of drinking water. Moreover, environmental impacts are almost irreversible at the present time, as mining tailings, mainly formed by iron oxide (Fe2O3), it can devastate large ecosystems (SANTOS).

A similiar case occurred in mid-January 2019, fouryears after the Mariana disaster. The Feijão Mine dam 1, located in the municipality of Brumadinho/MG, ruptured, causing a flood of mud to the region and causing huge human, environmental, economic and social damage.

On closer examination, the mud released by the dam breach covered about 205 (two hundred five) kilometers, with a tailings volume 50 (fifty) times lower than that of Mariana (CAETANO, 2019), however, reached one of the tributaries of the São Francisco River, the Paraopeba River, contaminating the RetiroBaixo Power Plant reservoir in Pompéu/MG, according to the Minas Gerais Institute for Water Management-Igam (MG1, 2019), as shown in the image below:

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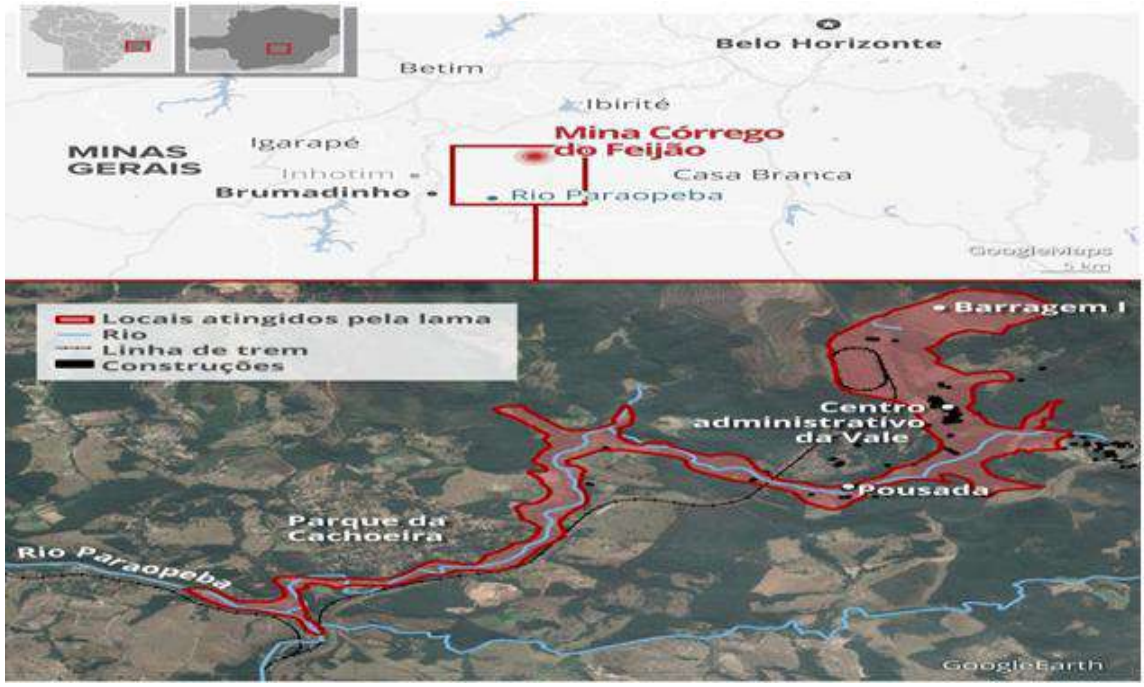

Fig. 2: Mud path in Brumadinho/ MG

Source: Figure extracted from the site of G1, report The Tragedy in Brumadinho: The path of mud(2019).

Facing the above cases, both disasters occurred in dams owned by CompanhiaVale do Rio Doce (CVRD). The fines imposed on Samarco, owner of the Fundão dam and owned by Vale, amount to "R$ 610 million by environmental agencies, R$346 million by Ibama, and R$ 370 million by the Minas Gerais Department of the Environment. Of this amount, only R$ 41 million was paid". In the case of Brumadinho, it is estimated that the fines amount to R$250 million by Ibama, R$ 99 million by the government of Minas Gerais, R$100 million by the Brumadinho City Hall and R$50 million by the Juatuba City Hall, Paraopeba River contamination (CAETANO, 2019).

Moreover, the mud released by the disruptionsreached regions close to the dams, forminga kind of coverage at the site as Eler mentions (2019), in the case of Brumadinho, the mud struck an area of 3,6 km^2, which would be equivalent to the area of 504 (Five hundred and four).The author also adds that there is a probability of nature never returning to what it was before, due to the type of residue being difficult to remove.To exemplify, the author cites the case of Mariana, where the places hit by the mud almost all remain the same way.

The cover made by mud leads to the impediment of the development of plant species, due to the absence of organic matter in the mud, leaving the infertile region. Also, due to the composition of the tailings, these end up affecting the ph of the earth, causing the chemical breakdown of the soil (SANTOS). Moreover, with the mud drying, there is an increase of dust, which leads to the elevation of the number of cases of respiratory problems. According to the data presented by the Institute of Health and Sustainability, approximately 35% of the residents of the Mariana region had a worsening in the health after the rupture of the dam (ELER, 2019).

The mud still affected the issue of water that, by advancing the Rivers, reached significant tributaries, such as the Doce River and the Paraopeba River.According to data analysis the level of copper present in the waters of the Rio Paraopeba reaches up to 600 (six hundred) times above the allowed rivers, used for the purpose of human supply, irrigation of plantations, fishing and recreation. In addition to minerals such as iron, manganese and copper, *choromium*was found at up to 42 (forty-two) times higher than acceptable in the legislation. In naonterview with agency Brasil EBC, biologist Marta Marcondes, professor na coordinator of theLaboratório de AnáliseAmbiental do Projetoíndice de PoluentesHídricos (IPH), of São Caetano do SulUniversity(USCS), explains that *chromium* is one of the most dangerous chemical elements due to its ability to genetically alter organisms, allowing further application, or the nervous system. In this regard, this substance will alter the entire process of

https://dx.doi.org/10.22161/ijaers.69.32 *ISSN: 2349-6495(P) | 2456-1908(O)*

homeostasis, that is, body's balance, detecting the likelihood of damage to the nervous system as well as degenerative diseases.

In the same way, the report released by the SOS Mata Atlântica Foundation, of march 2019, reveals that the river waters are not in conditions for the population to use. In addition, the tailings that are being sedimented ate the bottom of the river contribute to the lack of life, as the tailings will not disappear, but it can only be diluted at a certain time and eventually be taken to the sea, that is, the tailings if they are sedimented ate the bottom of the river need to be removed, since they are on top of all the life that they had at the bottom of the river, considered decomposers. These, in turn, contributed to the survival of other animals, as the biologist Marcondes explains.

Another relevant point to highlight is the psychological trauma.Disasters have impacts on the survivors mental health, as well as on the victims'families.In 2017, the UFMG Vulnerability and Health Research Center team conducted data collection for the PRISMMA survey, Mariana Mental Health Reality Survey, assessing 271 people. According to the survey data, almost a third of the population was diagnosed with depression. In addition, the survey also showed that 12% of participants have traces of posttraumatic stress disorder, an even more serious mental disorder. The rate is close to that found immediately after Japan's Fukushima nuclear accident in 2011 (PRISMMA, 2018).

Following, it is relevant to address another disaster: the fire of Ultracargo (G1 SANTOS, 2018). Occurred in the same year of the Mariana Dam rupture, the fire was the largest recorded in the history of the Port of Santos and registered by the São Paulo State Environmental Compamy – CETEsb. The damage caused by the fire resulted in economic damage to the fishing community around the terminal

The site of the fire is na industrial área, located off the coast of Santos, that housed 175 (one hundred, seventy five) tanks with storage capacity of up to 10.000m^3 each, within an area of 183.871 $m^{2.}$ The company Ultracargo works with liquid bulk storage, highlighting the storage of chemicals, petrochemicals, biofuels and vegetable oil. (LYRA, 2015).

According to the complaint filed by the Federal Prosecutor's Office (MPF) in Santos, Terminal Químico de Aratu S.A, a subsidiary company of Ultracargo, was reported for air, sea and soil pollution caused by the fire in the fuel transfer center. Of the company that affected 6 (six) fuel tanks during 8 (eight) days (MPF, 2018).

Based on the findings, the fire was caused by an operational error in the suction and discharge pipes. After a power outage the equipment was turned on by mistake, and the valves were closed, which caused enormous pressure, causing one of the valves to explode. The pumps, which contained the closed vavel, were close to the fuel tanks, which contained the closed valves, were close to the fuel tanks, which with the explosion quickly caught fire (SANTAPORTAL, 2016).

The engineer Elio Lopes clarified that the fire began with a phenomenon called *bleve*, that is, an explosion of the expanding vapors of a boiling liquid. In addition, he added, "this is because some employee inadvertently started a pump that had the suction and discharge closed and had fuel inside. It could be even water, anexplode just the same (SANTAPORTAL, 2016).

Moreover, based on the report by Cássia Lyra (2015, the manager of CETEsb – Environmental Company of the State of São Paulo – on the Baixada Santista, claimed that the fight against fire resulted in significant changes in water quality. This was due to the material dumped in the Santos Port Statuary that changed the temperature and oxygen saturation in the water. Accordingly, according to the federal criminal expert report requested by the Federal Public Prosecution Service, it caused the death of approximately 9 (nine) tons of fish of 142 (one hundred, forty-two) species, of which 15 (fifteen) are become threats of extinction.

Based on the Federal Procesecutor's Office (2018), Ultracargo's subsidiary was not only guilty, but acted with eventual intent by taking the risks of causing pollution and other environmental damage by operating with huge amounts of flammable products without taking preventive measures.

3.1.Analysis of the principles of prevention and polluter pays

The cases under analysis demonstrate that safety and environmental protection standards are probably not fulfilled in their integrality.

In the case of disruption of Fundão dam, the Public Prosecutor's Office has been identified as failures and omissions in relation to the environmental licensing process,not taking into account the potential risks of disruption and environmental damage. Furthermore, it is noted that from the time the Mariana disaster occurred to the present moment, the process of environmental licensing for mine operation, made them more flexible, rather than being stricter the rules (BBC NEWS,2019).

As a result, in 2017 it was approved the possibility of an "Express License" (PASSARINHO,

https://dx.doi.org/10.22161/ijaers.69.32 ISSN: 2349-6495(P) | 2456-1908(O)

2019), which allowed the process to occur in one step. The traditional environmental licensing process is carried out in three phases, which may take years to be released. However, concomitant environmental Licensing 1, acronym LAC 1, is carried out in a single step.

This LAC 1 was the type of licensing used by Vale, obtaining authorization to resume activities in the dam of the Córrego do Feijão,in December 2018, in order to reuse partof reject deposited there.The interest in resuming the activities was due to the new technologies that began to allow the use of the excavated material that was previously discarded. Fact is that the dam was deactivated since 2015 and after one month the Vale obtain the authorization to resume the activities, the dam broke (PASSARINHO, 2019).

With this, it is observed that the same errors previously committed in Mariana, were not repaired. The easing of environmental licensing,as well as the non-observances of the safety guidelines provided for in Law 12.334 (2010), referring to the national policy on safety of dams were the generating factors for the rupture of the Córrego do Feijão mine. In the questionof Ultracargo, the Federal Public Prosecutor's Office evidenced that the actions and omissions taken by the company regarding the event showednegligence, recklessness and incompetence of the same (MPF, 2018).Moreover, the risks of causing environmental damage, such as pollution and possible risk of extinction of some species found in the portof Santos statuary, it is denoting that the company acted with eventual intent (MPF, 2018) and, by not adopting preventive measures as well as not having an adequate system of operation that initially tackers the flames, frim ensuring rapid access to fire brigade to personal protective clothing and to the fixed fire-fighting foam system and still does not contain any means of containment of the liquid resulting from the firefighting to prevent flow for the estuary.

In this sense, a principiological analysis is necessary to.

Preliminarily, from the perspective of the principle of Prevention. Based on the Magna Carta of 1988, article 225 adopted the Principle of Prevention by highlighting the duty of the government and community to protect and preserve environmental goods.Thus, it is the State's role to properly punish the polluter, as well as to have a severe legislative framework that imposes fines and heavier sanctions as a means of effectively preventing prevention (FIORILLO, 2017, p.87 -88).

With regard to the imposition of fines, the State, it seems, has played its role.

Samarci, owner IF the Fundão dam and Vale company, was fined R$610 million by environmental agencies, R$370 million by the Minas Gerais State Department of the Environment and R$346 million by Ibama. Regardins these amounts only R$41 million was paid.

In addition, in relation to the breach of the dam in Brumadinho/MG, Vale was fined R$250 million by Ibama, R$ 100 million by the Brumadinho city government, R$ 99 million by the Minas Gerais government and R$99 million by the Minas Gerais government and R$50 million by the City Government of Juatuba, due to contamination of the Paraopeba River(CAETANO, 2019).

After an opinion from the Federal Public Prosecution Service regarding the Ultracargo fire, it was instituted that the Court imposed the fines provided for in articles 21 to 24 of the Environmental Crimes Law (Law n. 9605/98), applied in a manner compatible with the damages generated, as well as taking into account the economic group belonging to (MPF, 2018).

Based on information from CETEsb, Terminal Quimicode Aratu, owned by the Ultracargo Group, was initially fined R$ 22.5 million, but R$16 million was paid, due to a 3o% discount provided for in Law 6.514/08 (BRAZIL, 2018), which provide that the taxpayer will be entitled to this benefit if he/she makes the payment within the estimated 10 (ten) days. In addition, Santos City Hall imposed a fine of R$2.8 million to compensate for losses to urban mobility (ÉPOCA, 2015).

It is noteworthy that for the application of fines it is necessary to take into account the economic Power of the polluter, so that there is no distortion of the principle through an arithmetic calculation, as cited by Fiorillo (2017). As Bruna Caetano (2019) puts it, "the mining company closed the third quater of 2018 with net income of almost R$5,8 billion" and as Fontes adds, "from January to March, the company's net revenue was R$20, 74 billion", referring to the first quarter of 2019 of the Holding Company in which Ultracargo is one of the subsidiaries. Thus, when comparing the value of the fines to the income earned by the due companies, it is clear that these values are low, not having the effect due.

When analyzing the legislative framework, the Polluter-Paid Principle has as its central pillar, with a constitutional provision in paragraph 3 of article 225. According to Fiorillo (2017, p. 71), this principle has two strands of scope. At first, the attempt is made to avoid the occurrence of environmental damage, that is, it has a preventive character. Thus, they impose on the polluter

https://dx.doi.org/10.22161/ijaers.69.32 *ISSN: 2349-6495(P) | 2456-1908(O)*

the duty to prevent environmental damage that their economic activity may cause.

In a second moment, Fiorillo (2017) adds the idea that IF the damage has occurred, it has to be repaired, thus having a repressive character. In this respect, the principle shows that if damage to the environment occurs, due to the activity developed, the cause/polluter will be held responsible for its repair.

It is therefore noted that the Polluter Pays Principle entails the incidence and application of certain facets of the civil liability legal regime to environmental damage. These include objective liability, the priority of specific remediation of environmental damage and solidarity to withstand environmental damage (FIORILLO, 2017).

3.2. Environmental Criminal liability

Following the discussion, it is essential to point out that in the repressive character, as stated above, there is the incidence of civil liability. However, as provided for in the Magna Carta in the referred paragraph 3 of article 225, the enforceability of the obligation to make reparations, criminal or administrative penalties does not exclude their cumulative nature.

Under this bias, the constitutional text, noting the relevance of the environmental establishes it as a fundamental right. And, as a way of safeguarding this right, it showed the subjection of those causing environmental damage to sanctions. Taking into account the social consequences that certain behaviors cause, as well as the need for more severe intervention by the State, the list of sanctions, which highlights the criminal protection of the environment.

The infraconstitutional legislator, based on the constitutional text, created Law n. 9.605/98, which disciplines environmental crimes, as well as the applicability of penalties to the respective crimes.

According to Magalhães Noronha (apud PEREIRA, 2012), crime is a human conduct that endangers or harms a legal asset protected by criminal law. Thus, the Environmental Crimes legislation makes clear the conduct of the individual, in order to systematize the conduct harmful to the environment.

Among the provisions brought by the legislation, the possibility of penalizing the legal entity is highlighted, with focus on article 225, paragraph 3 of the Federal Constitution. In this respect, Brazil was the first Latin American country to create the theory of criminal liability of the legal entity, that is, the applicability of the penalty is not restricted only to individuals, but also to legal entities.

Despite the divergences in the application of criminal liability to legal entities, the doctrine of environmental law has a majority position in favor of its application. In this sense, the understanding prevails, as Pereira (2012) points out that, the cause of the damage, regardless of whether it is a legal or natural person, is liable both in administrative and criminal waiting, and should be taken into account that the individual, representative of the legal entity, acting on its behalf and for its benefit, be held liable at the same time.

Mention, for example, of the judgment in the file of Special Appeal n. 889.528/SC, issued by Minister Felix Fischer, who admitted the criminal liability of the legal entity in environmental crimes.

According to Brazilian Superior Court of Justice, the imputation of criminal liability of the legal entity in the case of environmental crimes is allowed. To the Court, there is simultaneous accountability of legal and natural persons, as they act with their own subjective element (STJ, 2006). However, in 2013, the Federal Supreme Court understood the possibility of holding the legal entity independent of the individual. For the Supreme Court, regardless of the conviction or acquittal of individuals holding management positions, it is fully possible for the legal entity to respond criminally (STF, 2013).

Importantly, according to Costa and Marotta (2017) the Federal Supreme Court understood that the Brazilian Constitution of Republic of 1988 has conditioned the criminal liability of the legal person to that of the physical persons causing the damage.

Based on the analysis of probable environmental crimes in the three cases presented, these are framed in the crimes of pollution, extraction of mineral resources and storage of toxic products or substances that are in disagreement with the preventive measures laid down in laws or regulations, provided for in articles 54, 55 e 56, respectively of the Environmental Crimes Act n. 9.605/98.

About the pollution crime, in an objective way, in accordance with article 56 of the Law n. 9605/98 (Brazil, 1998), are those who, of any nature, may cause harm to human health, as well as the death of animals or the destruction of a relevant form of the flora, one who acts guilty may be punished. Moreover, those who fail to take precautionary measures for the extraction of minerals or the handling of toxic substances, more specifically, flammable.

As noted, environmental protection has been incorporated into the constitutional text provided for in article 225, implemented by the most severe form of

https://dx.doi.org/10.22161/ijaers.69.32 *ISSN: 2349-6495(P) | 2456-1908(O)*

protection in force in the Brazilian legal system, criminal protection.

The companies, in the cases studied here – related to the incidents that occurred in the Minas Geraiscities of Mariana and Brumadinho – may, in theory, be held criminally responsible for the environmental crimes that occurred. However, although some indoctrinators (Fiorillo, 2017) argue that any conduct that causes environmental damage would constitute illicit, with the consequent application of sanctions, caution must be exercised in criminal policy, requiring detailed investigation of the fact and strict compliance law.

From the perspective of the principle of Prevention it is important to clarify that this accountability does not seek to make economic activity unfeasible, but only to punish the polluter who does not understand that natural resources are exhaustible and scarce, and that they do not belong to an individual or a determined individual and "its use of others, because the environmental good is a common good of the people" (2017, p. 87).

Under this bias, it is right to address the characteristics of environmental law, one of the main principles being sustainable development. Thus, one has the idea that there must be a harmonization between the development of a society, along with the preservation of natural resources, allowing present and future generations to have access to these rights(FERREIRA, 2018).

In this sense, we understand the 17 UN Sustainable Development Goals that together "are integrated and indivisible, and balance the three dimensions of sustainable development: the economic, social and environmental" (Agenda 2030, 2015).

IV. CONCLUSION

The present study addressed the principles of prevention and the principle of the debtor-payer, in order to demonstrate the urgent need to comply with standards of and environmental regulations on the parto f national companies. This need can be demonstrated by the cases addressed throughout the text, which revealed the absence of the adoption of preventive measures and the practice of the same misconceptions that cause enormous environmental tragedies.

In short, these environmental disasters serve as an alert to the occurrence of possible new disasters. It is necessary to raise awareness that environmental resources are dupable sources, goods of common use for all generations, demonstrating the need for its preservation and exploitation in a sustainable way.

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https://dx.doi.org/10.22161/ijaers.69.32 *ISSN: 2349-6495(P) | 2456-1908(O)*

Antifungal and Antiplasmodial Activity of Isolated Compounds from *Handroanthus serratifolius* (Vahl) S. Grose Sawdusts

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Abstract *— Handroanthus serratifolius (Vahl) S. Grose [Tabebuia serratifolia (Vahl) G. Nicholson] popularly known in Brazil "ipê-amarelo" is a woody species with potential of sustainable use belonging to a genus known for being as a promising naphthoquinones source which has aroused interest in search for new biological activities. In this paper, the methanolic extract fractionation from H. serratifolius sawdust using different chromatogramphic techniques yielded naphthoquinones dehydro-α-lapachone, dehydro-iso-α-lapachone and α-lapachone, along with lignans paulownin and cycloolivil. The three naphthoquinones presented antiplasmodial activity against Plasmodium falciparum where the dehydro-iso-α-lapachone was more active (IC50 of 7.53 µg/mL). This same compound also exhibited significant antifungal activity against Cryptococcus neoformans.*
Keywords *—* ***Bignoniaceae, Cryptococcus neoformans, lignans, naphthoquinones, Plasmodium falciparum.***

I. INTRODUCTION

Handroanthus serratifolius (Vahl) S. Grose [*Tabebuia serratifolia* (Vahl) G. Nicholson] (Bignoniaceae) is a woody species with potential of sustainable use, and with a large occurrence in South America[1]. The trunk medium diameter ranging from 20-90 cm in this species foments furniture confection beyond its medicinal importance, especially the heartwood is used for pharmacological substrate. Popularly known in Brazil as "ipê", "ipê-amarelo" and "pau-d'arco", it is commonly used in landscaping and urban arborisation due to its attractive yellow flowers[2]. Phytochemical studies with *H. serratifolius* (ipê-amarelo) are scarce, there are reports of two naphthoquinones derivative of lapachol from stem bark[3]. The naphthoquinones of Bignoniaceae have been much investigated in the last decades, especially lapachol and analogs α-lapachone and β-lapachone, which are isolated from the heartwood and exhibit a diversity of biological activities[4,5]. The interest in three natural naphthoquinones as well as their semi-synthetic derivatives has intensified the search for new antifungal of medical interest[6-8] and antimalarial agents[9-11].

Malaria remains an important infectious disease, which is most prevalent in the tropical and poor regions of African countries. In 2017, according to the latest estimates from WHO, there were 219 million new cases, with 435,000 deaths, especially in children under five years of age[12]. The appearance of *Plasmodium falciparum* resistance to many antimalarial medicines is a concern in the fight against malaria; all over the world including in Brazil[13,14]. In this context, it is important the discovery of new drugs with new targets. Thus, in this study, we investigated antifungal and antiplasmodial potential of naphthoquinones and lignans isolated from the heartwood residues of *H. serratifolius*. Spectroscopic characterization of the compounds is also presented.

II. MATERIAL AND METHODS

General experimental procedures

NMR spectra were measured in a Bruker DRX 400

https://dx.doi.org/10.22161/ijaers.69.32 *ISSN: 2349-6495(P) | 2456-1908(O)*

apparatus; chemical shifts (δ) were expressed in ppm, and coupling constants (*J*) in Hertz; TMS was used as internal standard. Deuterated solvens chloroform and methanol was purchased from Sigma-Aldrich (St. Louis, MO, USA**).** LC-HRMS measurements were obtained using a MicroTOF-QII (Bruker Daltonics) mass spectrometry connected to a Prominence UFLC (Shimadzu) LC. Melting points were determined on a Fisatom 430D apparatus. Fractioning by medium pressure liquid chromatography (CLMP) was performed on CLMP–Sepacore® Buchi equipped with control unit (C-620), fractions collector (C-660), binary pump (C-605) and UV (C-640). Column chromatography (CC) was performed with silica gel 60 (Merck, 70-230 and 230-400 mesh), cellulose (Merck), Sephadex LH-20 (Sigma-Aldrich) and Amberlite XAD-2 (Supelco). Analytical TLC was performed with silica gel 60 F_{254} (0.25 mm) pre-coated alumina sheets (Merck) visualized using UV light (254 and 365 nm), vanillin-sulphuric acid and NP/PEG reagent spray.

Obtaining of wood residues and extraction

Samples of wood residues were obtained from the Experimental Station of Tropical Forestry located at km 50 of BR-174, the basis of forest management of the Instituto Nacional de Pesquisas da Amazônia (INPA). These residues were classified and identified through macroscopic comparisons with standard samples of *H. serratifolius* available in the Xylotheque of INPA. Larger residues were previously evaluated about their technological properties of wood and use for experiments in the production of artifacts in the Laboratory of Engineering of Wood Artifacts. The resulting minor residues (sawdusts) from these procedures were available for phytochemical studies. Thus, sample of sawdusts from *H. serratifolius* heartwood (295.56 g) was extracted with n-hexane and then methanol providing 0.84 of hexane extract and 19.14 g of methanolic extract.

Chromatographic fractionation of methanolic extract

The methanolic extract (16 g) was fractionated over silica gel column (70-230 mesh) eluted with hexane, hex:CH_2Cl_2 (1:1), CH_2Cl_2, CH_2Cl_2:MeOH (10-50%) to yield twenty-one fractions. The grouped fractions 7-11 (TSM-7, 1.86 g) and 14-15 (TSM-14, 6.52 g) were subjected to further chromatographic fractionation. TSM-7 fraction was subjected to a microcrystalline cellulose column using hexane, hex:AcOEt (95:5) resulting in purification of compound **1** (10 mg) and mixture (368 mg) of two compounds that were purified on MPLC system using silica gel (230-400 mesh), eluting with hex:EtOAc (9:1) and hex:EtOAc (8:2) to give **2** (4.0 mg) and **3** (13.0 mg). TSM-14 fraction fractionated over silica gel column (70-230 mesh) eluted with hexane, hex:CH_2Cl_2 (20-50%), CH_2Cl_2 and CH_2Cl_2:MeOH (10-50 %), resulted in twenty-one fractions of which frs. 16-19 (2.35 g) were submitted to further silica gel columns chromatography followed by Sephadex LH-20 to give compounds **4** (9.0 mg) and **5** (14 mg).

Microorganisms reference strain and antifungal susceptibility testing

Strains of *Cryptococcus neoformans* (VN1 PCN6) and *Candida albicans* (ATCC 36232) of the culture collection from Instituto Nacional de Pesquisas da Amazônia-INPA, Manaus-AM, were used. These cultures were preserved through lyophilization process, later they were reactivated in Sabouraud Agar Dextrose. An inoculum was removed from the culture and suspended in 5.0 ml of sterile saline 0.085% and placed in vortex for 15 seconds. The cell density was adjusted equivalent to a standard solution of 0.5 McFarland. The suspension for testing was obtained by making a 1/100 dilution followed by a 1/20 dilution in RPMI 1640 (Sigma-Aldrich) buffered with 4-Morpholinepropanesulfonic acid to the required concentrations for the assays according to CLSI[15].

Minimum inhibitory concentration (MIC) assays were performed with the broth microdilution method[15]. Briefly, 100 μL of each evaluated compound diluted in RPMI 1640 broth was added to 96-well microplates, with the initial concentrations of 320 μg/mL. Amphotericin B was used as the antifungal standard. Next, 100 μL of an inoculum containing 2.5 ×103 cells/mL of the reference microorganism was added to 96-well microplates. The microdilution plates were incubated at room temperature (35°C) for 24 h. The amount of growth in the tubes containing the tested compound was visually compared with the amount of growth in the growth-control tubes (no antifungal agent) used in each set of tests.

Plasmodium falciparum cultures and Antiplasmodial tests

To assess the schizonticide activity of the compounds against *P. falciparum in vitro* were used trophozoite stages in sorbitol-synchronized with approximately 1–2% parasitemia and 2.5% haematocrit[16]. All parasites were maintained in continuous culture on human erythrocytes (blood groups A + or O +) using RPMI medium supplemented with 10% human serum as described by Trager & Jensen[17]. Then, erythrocytes were distributed in a 96-well plate. The drug stock solutions were prepared in 1% DMSO and further serially diluted (50–0.78 ug/mL) in complete culture medium. Blood smears were collected after 48 hours, methanol fixed and Giemsa stained, codified and read blindly. The antiplasmodial effect of the isolated compounds was measured by the inhibition of *P.*

https://dx.doi.org/10.22161/ijaers.69.32 *ISSN: 2349-6495(P) | 2456-1908(O)*

falciparum blood parasite growth relative to the control cultures in complete medium without drugs. The parasitemia was observed by optical microscopy. Negative controls were cultures free of treatment, culture in 1% DMSO and culture with addition of distilled water. The parasitemia in control groups without treatment was considered 100%.

The activity of the drug was expressed as the percentage of parasitemia inhibition compared to controls without drugs. Compounds that inhibited between 80 and 100% growth of the parasites were considered active; partially active when the inhibition was between 50 and 79%, and when the inhibition was lower than 50%, the drug was considered inactive[18]. The half-maximal inhibitory (IC_{50}) concentration responses were estimated by linear interpolation, as compared to the drug-free controls. A chloroquine control (as a reference antimalarial drug) was used in each experiment. Diluted at a ratio of 1:3 starting from 2500 ng/mL to 3.42 ng/mL in complete culture medium. All experiments were performed in duplicate or triplicate, and the slides were coded for quantification of parasitemia.

Analytical and spectral data of isolated compounds

Dehydro-α-lapachone (**1**): crystallin, orange-colored solid, mp 139–140ºC. HRMS m/z 241.0902 $[M+H]^+$. ^1H NMR (400 MHz, TMS, $CDCl_3$, δ, ppm, J/Hz): 8.10-8.09 (2H, m, H-5 and H-8), 7.72-7.68 (2H, m, H-6 and H-7), 6.66 (1H, d, J = 10.0, H-11), 5.73 (1H, d, J = 10.0, H-12), 1.56 (6H, s, H-14 and H-15). ^{13}C NMR (100 MHz, $CDCl_3$, δ, ppm): 181.9 (C-4), 179.9 (C-1), 152.5 (C-2), 134.0 (C-6), 133.2 (C-7), 131.6 (C-9), 131.5 (C-10), 130.9 (C-12), 126.2 (C-5 and C-8), 117.9 (C-3), 115.5 (C-11), 80.5 (C-13), 28.4 (C-14 and C-15).

Dehydro-iso-α-lapachone (**2**): crystallin, yellow-colored solid, mp 109–110^{0}C. HRMS m/z 241.0848 $[M+H]^+$. ^1H NMR (400 MHz, TMS, $CDCl_3$, δ, ppm, J/Hz): 8.10-8.07 (2H, m, H-5 and H-8), 7.74-7.66 (2H, m, H-6 and H-7), 5.42 (2H, dd, J = 10.9 and 8.6, H-12), 5.13 (1H, s br, H-14), 5.01 (1H, sl, H-14), 3.36 (1H, dd, J = 17.2 and 10.9, H-11), 3.04 (1H, dd, J = 17.2 and 8.6, H-11), 1.81 (3H, s, H-15). ^{13}C NMR (100 MHz, $CDCl_3$, δ, ppm): 182.3 (C-4), 177.7 (C-1), 160.1 (C-2), 141.7 (C-3), 134.2 (C-6), 133.0 (C-7), 131.6 (C-10), 126.4(C-8), 126.1 (C-5), 124.0 (C-9), 114.0 (C-14), 88.5 (C-12), 32.0 (C-11), 16.9 (C-15).

α-Lapachone (**3**): crystalline, yellow greenish solid, mp 119–120ºC. HRMS m/z 243.1029 $[M+H]^+$. ^1H NMR (400 MHz, TMS, $CDCl_3$, δ, ppm, J/Hz): 8.10-8.06 (2H, m, H-5 and H-8), 7.70-7.67 (2H, m, H-6 and H-7), 2.62 (H-11, t, J = 6.6, H-11), 1.82 (2H, t, J = 6.6, H-12), 1.44 (6H, s, H-14 and H-15). ^{13}C NMR (100 MHz, $CDCl_3$, δ, ppm): 184.4 (C-4), 180.0 (C-1), 154.7 (C-2), 133.9 (C-6), 132.9 (C-7), 131.2 (C-9), 132.1 (C-10), 126.3 (C-8), 126.0 (C-5), 120.2 (C-3), 78.2 (C-13), 31.5 (C-12), 26.5 (C-14 and C15), 16.7 (C-11).

Paulownin (**4**): crystalline, colourless solid, mp 78.3–81.0^{0}C. HRMS m/z 371.1116 $[M-H_2O\ H]^+$ and *m/z* 353.1014 $M+H]^+$. ^1H NMR (500 MHz, TMS, $CDCl_3$, δ, ppm, J/Hz): 6.95 (1H, d, J= 1.7 Hz, H-2), 6.92 (1H, d, J = 1.6, H-2'), 6.88 (1H, d, J = 8.0, H-6'), 6.87 (1H, dd, J = 8.0 and 1.7, H- 6), 6.85 (1H, d, J = 8.0, H-5), 6.80 (1H, d, J = 8.0, H-5'), 5.99 (2H, s, H-10'), 5.96 (2H, s, H-10), 4.83 (1H, s, H-7'), 4.86 (1H, d, J = 5.0, H-7), 4.53 (1H, dd, J = 9.2 and 8.1, H-9ax), 4.06 (1H, d, J = 9.4, H-9'ax), 3.92 (1H, d, J = 9.4, H-9'eq), 3.85 (1H, dd, J = 9.2 and 6.1, H-9eq), 3.07 (1H, ddd, J = 8.0, 6.1 and 5.0, H-8). ^{13}C NMR (75 MHz, $CDCl_3$, δ, ppm): 148,2 (C-4'), 148.0 (C-4), 147.9 (C-3'), 147.3 (C-3), 134.6 (C-1'), 129.1 (C-1), 119.8 (C-5), 120.1(C-6'), 108.6 (C-6), 108.2 (C-5'), 107.4 (C-2'), 106.9 (C-2), 101.3 (C-10'), 101.1(C-10), 91.6 (C-8'), 87.5 (C-7'), 85.8 (C-7), 74.8 (C-9'), 71.6 (C-9), 60.4 (C-8). HMBC (300 x 75 MHz, $CDCl_3$): 6.95 → 147.3, 85.8; 6.92 → 87.5; 6.88 →148.2, 107.4, 87.5; 6.87 → 148.0, 129.1, 106.9, 85.8; 6.85 →148.0, 129.1; 6.80 → 147.9, 134.6, 120.1; 5.99 →148.2; 5.96 →148.0; 4.86 →129.1, 91.6, 71.6, 60.4; 4.83 →134.6, 107.4', 120.1; 4.53 → 85.8, 60.4; 4.06 → 91.6, 85.8, 60.4; 3.92 → 91.6, 85.8, 60.4; 3.85 → 85.8, 60.4; 3.07 → 29.1, 91.6.

Cycloolivil (**5**): Amorphous, white solid, mp 164–66ºC. HRMS m/z 375.1567 $[M-H]^+$. ^1H NMR (400 MHz, TMS, MeOD, δ, ppm, J/Hz): 6.75 (1H, d, J = 8.0, H-5'), 6.70 (1H, d, J = 1.9, H-2'), 6.66 (1H, dd, J = 8.0 and 1.9, H-6'), 6.62 (1H, s, H-2), 6.18 (1H, d, J = 0.8, H-5), 4.02 (1H, d, J = 11.7, H-7'), 3.81 (1H, dd, J = 11.1 and 2.6, H-9'a), 3.78 (1H, d, J = 11.1, H-9a), 3.77 (3H, s, OMe-3'), 3.59 (1H, d, J = 11.1, H-9b), 3.58 (1H, dd, J =11.1 and 4.2, H-9'b), 3.21 (1H, d, 16.7, H-7eq), 2.61 (1H, d, J = 16.7, H-7ax), 2.03 (1H, ddd, J = 11.7; 4.2 and 2.6, H-8'). ^{13}C NMR (100 MHz, MeOD, δ, ppm): 147.7 (C-31), 146.1 (C-3), 144.7 (C-4'), 143.9 (C-4'), 137.2 (C-1'), 132.1 (C-1), 125.0 (C-6), 122.2 (C-6'), 115.9 (C-5), 114.6 (C-5'), 112.5 (C-2'), 111.6 (C-2), 73.6 (C-8), 68.0 (C-9), 59.4 (C-9'), 54.9 (OMe-3'), 46.2 (C-8'), 43.5 (C-7'), 38.5 (C-7). HMBC (400 x 100 MHz, MeOD): 6.75 → 137.2, 147.7, 144.7; 6.70 → 147.7, 144.7, 122.2, 43.5; 6.66 → 144.7, 112.5; 6.62 →146.1, 143.9, 132.1, 38.5; 6.18 → 146.1, 125.0, 43.5; 4.02 → 137.2, 132.1, 122.2, 112.5, 59.4, 46.2; 3.81 →73.6, 46.2; 3.58 → 73.6, 46.2; 3.21 → 132.1, 125.0, 111.6, 73.6, 68.0, 46.2; 3.78 → 73.6, 46.2, 38.5; 3.77 → 147.7; 3.59 → 73.6, 46.2, 38.5; 2.61 →

https://dx.doi.org/10.22161/ijaers.69.32 *ISSN: 2349-6495(P) | 2456-1908(O)*

132.1, 125.0, 111.6, 73.6, 68.0, 46.2; 2.03 → 137.2, 59.4, 43.5.

III. RESULTS AND DISCUSSION

Phytochemical studies with heartwood sawdusts from *H. serratifolius* using different chromatographic techniques resulted in the isolation of compounds identified as dehydro-α-lapachone (**1**), dehydro-iso-α-lapachone (**2**), α-lapachone (**3**), paulownin (**4**) and cycloolivil (**5**) (Figure 1). Compounds **1** and **3** were identified on basis of ^{1}H and ^{13}C NMR spectral data and comparison with literature[19] as pyranonaphthoquinone dehydro-α-lapachone and α-lapachone, respectively. In previous studies with heartwood from *H. serratifolius*, dehydro-α-lapachone was detectados by GC/MS as predominant compound[20]. The ^{1}H and ^{13}C NMR spectral data allowed identification of **2** as dehydro-iso-α-lapachone whose data were similar to those published by Ribeiro et al[21]. Identification of lignans **4** and **5** was based on experiments ^{1}H and ^{13}C NMR, and HMBC. ^{1}H and ^{13}C NMR data are in accordance with those reported in the literature as paulownin[22,23] and cycloolivil[24], respectively. In this study furanonaphthoquinone **2** and lignans **4** and **5** are being reported for the first time from ipê-amarelo wood.

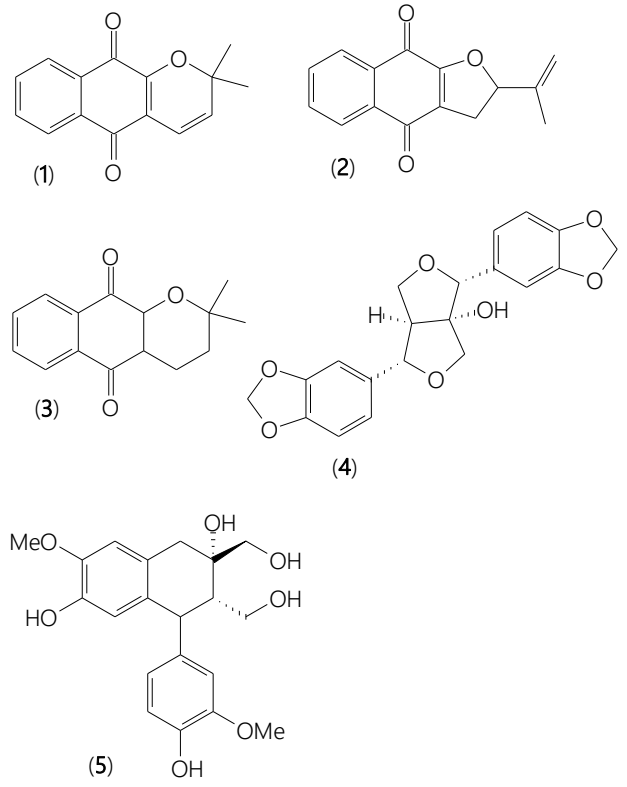

Fig. 1: Compounds isolated from heartwood sawdusts of H. serratifolius

Naphthoquinones and lignans were tested against pathogenic strains of *Cryptococcus neoformans* and *Candida albicans* (Table 1). Dehydro-iso-α-lapachone (**2**) showed a moderate effect (40 µg/mL) against *C. neoformans* strains. Interest in antifungal activity of synthetic and natural naphthoquinones have intensified in recent years. The importance of the search for natural prototypes for these pathogens is due to the small number of drugs available for treatment, the adverse effects associated with the use of certain compounds and the increasing incidence of antifungal resistance[25-27].

Table 1. MIC (µg/mL) of compounds from H. serratifolius against Cryptococcus neoformans and Candida albicans

Compounds	*C. neoformans* VNIPCN6	*C. albicans* ATCC 36232
1	80	> 320
2	40	160
3	160	160
4	80	> 320
5	> 320	> 320
Amphotericin B	0.125	0.25

The compounds were evaluted for their *in vitro* antimalarial activity against *Plasmodium falciparum* W-2 a chloroquine-resistant strain. Table 2 shows that naphthoquinones were considered active, the highest activity was observed for furanonaphthoquinone **2** (IC_{50} 7.53 µg/mL). The results suggest that the furan-type heterocyclic ring of **2** is important in bioactivity when compared to the pyran ring of naphthoquinones **1** and **3**. Lapachol derivatives are source of inspiration for structural modifications by synthetic transformations for developing new and more active products antiplasmodial against *P. falciparum*[9,10]. Lignans containing furofuran (**4**) and dibenzilbutane (**5**) skeleton were inactive suggesting chemical transformation for obtaining of their synthetic analogues more active because this class of compounds also has potential antimalarial.

Table 2. Antiplasmodial activity (IC_{50} µg/mL) of compounds 1-5 against Plasmodium falciparum (W-2)

Compounds	IC_{50}
1	21.12
2	7.53
3	14.00
4	≥ 50
5	≥ 50

IV. CONCLUSION

Phytochemical and biological research on wood residues from species with potential for sustainable use resulted in the identification of compounds with

https://dx.doi.org/10.22161/ijaers.69.32 *ISSN: 2349-6495(P) | 2456-1908(O)*

antimicrobial and antiplasmodial activity. The obtaining of residues from *H. serratifolius* heartwood from the area of management and studies of the technological properties of wood was an opportunity for the increase of knowledge of its secondary metabolism as well as to find active principles.

ACKNOWLEDGEMENTS

The authors thank the Brazilian Agencies Conselho Nacional de Desenvolvimento Cientifico e Tecnológico (CNPq), Fundação de Amparo a Pesquisa do Estado do Amazonas (FAPEAM) for their financial support.

AUTHOR CONTRIBUTIONS

LESM performed the extraction, isolation and identification of constituents. KSC, PILS and JVBS performed in the microbiological activities. CCN performed the identification and anatomical analysis of wood. BMMM and VFAN performed the antiplasmodial assay, AGF performed the NMR experiments. MPL designed the study and supervised the phytochemical laboratory. All authors have read and approved the final manuscript.

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https://dx.doi.org/10.22161/ijaers.69.33 *ISSN: 2349-6495(P) | 2456-1908(O)*

Queue theory Applied to the care of Pregnancies related to Pregnancy, Childbirth and the Puerperium

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Abstract**—** *This work investigates the increased length of care related to pregnancy, childbirth and the puerperium. It also proposes a simple approach to illustrate the effect of poor care in a maternity hospital. Applying Queue Theory with the Kolmogorov-Smirnov Test. In addition, it provides evidence that non-emergency patients, and also because of the lack of useful information in the primary care process, contribute to prolonged delays for all patient classes. Proposes a priority queuing model to reduce average wait time.*
Keywords**— Length of stay; Capacity management; Occupancy rate; Emergency patient flow.**

I. INTRODUCTION

Queues can be found in many everyday situations and are responsible for wasted time, productivity and money. Depending on their nature, queues can lead to personal and collective disruption, serious financial, economic, organizational and even life-threatening problems. For Peres et al. (2019) Patients are affected by the lack of availability of convenient times on the provider's schedule, especially when their care is urgent, and providers are affected by the uncertainty of appointments each day and the variety of cases that may arise.

According to Fogliatti and Mattos (2007), a queuing system can be defined as a process in which users from a certain population arrive to receive a service for which they expect, if necessary, to leave the system as soon as the service is completed. This wait happens when demand is greater than the service capacity offered, in terms of flow.

Existence as well as waiting time in queues is related to the efficiency and the ability of the system to provide services. The study of processes and queues aims at adapting the system in question to a queue model that allows the minimization of waiting times and, consequently, increase the efficiency of the studied system. According to Mendonça (2014), the objective of the queues study is to estimate the parameters involved in the model and to calculate some measures of its performance, considering the particularities of each case and, thus, to search systems that efficiently meet the needs of those who seek the service without let the system be idle for a long time.

Operational Research, through Queue Theory, is used to study queuing processes to produce real process performance indicators and proposed scenarios that will assist in decision making to minimize queue size and the permanence of individuals in them.

Care for pregnant women, parturients, mothers and newborns is a central problem in health systems worldwide (WHO, 2005). According to data from the Department of Information and Informatics of the Brazilian Unified Health System (DATASUS), between 2010 and 2016, more than 50 unborn children died, in addition to a total of over 100 maternal mortality related to pregnancy, childbirth and puerperium in the São Mateus microregion

https://dx.doi.org/10.22161/ijaers.69.33 *ISSN: 2349-6495(P) | 2456-1908(O)*

(comprised of the municipalities of São Mateus, Pedro Canário, Jaguaré and Conceição da Barra). It is noteworthy that the need to reduce maternal mortality rates, humanize births and the health prospects of unborn children depend, among other factors, also fundamentally on the quality and speed of care in health services. According to the National Health Agency (ANS), waiting time for care plays an unquestionable role in the health of pregnant women, mothers and newborns.

According to Dong et al. (2018), Delay announcements, common in service systems, can be used to influence quality perceptions and customer sentiment toward the service provider. In addition, these announcements may affect customer choices regarding emergency service providers, with subsequent effects on actual system operations.

According to Shi et al. (2015), a key factor contributing to the overcrowding of the emergency department (ED) is the extended waiting time for admission to inpatient wards, also known as hospital boarding time. However, there are no systematic records of waiting times for hospitalizations related to pregnancy (pregnancy, childbirth and the puerperium) in the Unified Health System (SUS). To estimate these times, we used the models of queuing theories that have been widely applied in health. Silva et al. (2018) applies the concepts of Queue Theory to analyze referrals from SUS patients to the medical specialty of angiology. The literature indicates that such models are particularly useful in analyzing childbirth-related phenomena. Although natural, the phenomenon of childbirth is a kind of emergency, since the moment of occurrence cannot be perfectly predicted and whose process, once triggered, cannot be much delayed. Delay in care usually entails serious health risks for the parturient and the unborn child. On the other hand, births cannot be freely scheduled either. The moment of childbirth has a strongly random character, which gives the phenomenon a degree of exogeneity appropriate to the queuing theory models that will be used in the present work.

II. LITERATURE REVIEW

According to Haghighinejad et al. (2016), are elements of the queue: arrival process of customers; attendance process; queuing discipline and system capacity. In the opinion of Komashie et al. (2015), the Queue Theory study proves to be a tool that ensures optimization of service companies, a fact that can generate the satisfaction of system users.

According to Lima et al. (2016), queuing theory consists in obtaining adequate models of circumstances involving queues, thus predicting their behavior. This behavior is expressed by a number of performance measures, namely customer arrival rate and system service rate.

Fogliatti and Mattos (2007) point out that a characteristic queued system is determined by the arrival of customers who need a certain service, they wait in a queue that forms as the service capacity is less than the demand of the users, are served and leave the system then. Figure 1 illustrates an arbitrary queued system.

Brahma (2013) reports that in hospitals, queuing theory can be used to assess a multitude of factors such as prescription time, patient waiting time, patient counseling time, and staffing levels. Applying queuing theory can be particularly beneficial in hospitals with high-volume outpatient workloads and / or those providing multiple service points.

Cho et al. (2017) emphasize that due to the characteristics of medical services, it is very difficult to predict exactly when a patient will arrive and how long it will take for the service. Therefore, the ultimate goal of queuing theory is to achieve an economic balance between cost of service and patients' time wasted while waiting in line to be served.

For Hamacher (2017), the process of arrival of a user in the system can be deterministic when the amount of arrivals and the moments in which they occur are known, or stochastic, when there is a random behavior. Stochastic processes are characterized by probability distributions.

The arrival of customers in the system is also classified by Fogliatti and Mattos (2007) as individual or in groups. An example for the individual case is the arrival of a car in a parking lot of a mall. For group arrival, an example is data packets waiting to be processed.

Also called service stations, the number of service channels is classified by Hamacher (2017) as finite or infinite. The finite case is exemplified by boxes in a bank and infinity in self-service calls.

https://dx.doi.org/10.22161/ijaers.69.33 *ISSN: 2349-6495(P) | 2456-1908(O)*

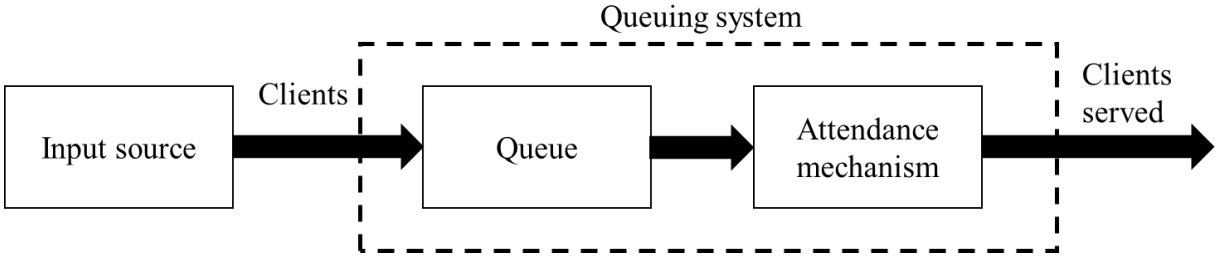

Fig. 1: Schematic representation of a queued system.

According to Brahma (2013), by better understanding queuing theory, service managers can make decisions that increase the satisfaction of all relevant groups - patients, staff and management.

Bhattacharjee and Ray (2018) define a system's capacity as the maximum number of users it can handle - including queue and service - and can be finite or infinite. When capacity is finite, customers arriving at the system after the maximum capacity is reached are not met. In the case of infinite capacity, one can cite the waiting for ships to attend a waterway environment for unloading in a port.

According to Fogliatti and Mattos (2007), the most commonly used service orders, or service literature, are: First In - First Out (FIFO): The service is performed according to the order of arrival; Last In - First Out (LIFO): The last user to arrive is the first to be served; Priority Service (PRI): Priority Service determined by system management is used for the occurrence of calls; e Service In Random Order (SIRO): Service is performed in random order. For the authors it is important to know and also understand what type of queue the system analyzed has, in its various service stations or units.

Bhattacharjee and Ray (2018) point out that Kendall-Lee Notation is a universally used way of describing systems and thus simplifying their analysis by using five characteristics described as follows.- A/B/C /D/E – Where: A: refers to the probability distribution type of the system arrival process; B: refers to the type of probability distribution of the care process; C: determines the number of service stations in parallel; D: indicates the physical capacity of the system; and E: makes mention of the discipline of the queue.

Parameters A and B can assume D, M, E_k e G, where D indicates a deterministic or degenerate distribution, M denotes an Exponential (Memoryless or Markovian) distribution, E_k represents an Erlang distribution of the type k and G refers to an unspecified distribution.

For example, the notation $D/D/1/\infty/FIFO$ represents a system in which the intervals between successive arrival of users to the system and the attendance times behave according to a deterministic distribution. There is only one service desk, the system has infinite capacity and the service takes place according to FIFO discipline.

The Markovian process, according to Dai and Shi (2017), is a stochastic (probabilistic) process that has the property called memoryless. According to this property, the probability distribution of an event is independent of the events that occurred before it, but depends on the current state. A Markov chain is a sequence $X_1, X_2, X_3, ..., X_n$ of random variables. The scope of these variables, that is, the set of values they can assume, is called the state space, where X_n denotes the state of the process in time n. If the conditional probability distribution of X_{n+1} in the past states is a function only of X_n, so:

$$P_r(X_{n+1} = x / X_0, X_1, X_2, ..., X_n) = P_r(X_{n+1} = X_n),$$

where X it is some state of the process. The above identity defines Markov property.

The Markov Chain is a Markov process and can be represented by a diagram showing the discrete states of a system through nodes, and the transitions between these states through arcs (GNEDENKO, 2018). State is defined as the number of users in a system. A process of birth and death is a Markov Chain where, given state n, the only possible changes are to state $n+1$ or $n-1$. Birth is the change to state $n+1$ and death to the state $n-1$. Transitions depend only on the state of the system, through and, which are the user arrival and user attendance rates, respectively.

For Chan et al. (2016), performance measures should be used to evaluate the efficiency of a system by analyzing its characteristics. According to Dai and Shi (2017), the most commonly used performance measures are: L: average number of clients in the system; L_q: average number of clients queued; W: average waiting time on

https://dx.doi.org/10.22161/ijaers.69.33 *ISSN: 2349-6495(P) | 2456-1908(O)*

any customer's system; W_q: average queue time for any customer; $P(N \leq n)$: It is likely that there will be no more than n; $P(T_q > t)$: probability that a customer will have to wait more than one time t in line; and $P(N < c)$: probability that a system with c service stations has some idle server.

Probability distributions can be continuous or discrete. According to Chan et al. (2016), a probability distribution of a discrete variable is the set of values of a discrete Random Variable (RV) and their respective probabilities. The difference for continuous variables is that, according to Dai and Shi (2017), instead of variable values, there is a range of values.

Next, only the exponential distribution will be addressed, as this is the one that fits the case study approached by this paper. For Gnedenko (2018), Exponential distribution is a continuous distribution that is widely used in queuing theory to describe the time spent developing a task. This author defines the exponential cumulative distribution function as follows (Equation 1):

$$F(x) = 1 - e^{\frac{x}{\alpha}}, \text{ since } x, \alpha > 0 \quad (1)$$

Where: x is the value of the random variable; and α is the mean value of the random variable.

However, after identifying the distribution, according to Hamacher (2017), it is necessary to perform adherence tests. These authors emphasize that the adherence test is a way of verifying if a population P follows a specified distribution P_0, that is, to verify the null hypothesis $H_0 : P = P_0$.

There are basically two types of adherence test: the Chi-square test, preferably used in discrete distributions, and the Kolmogorov-Smirnov test, preferably used in continuous distributions. Next, only the Kolmogorov-Smirnov test is presented as it was used in this work, due to the continuous characteristic of the variable in question - the time. According to Kasjanov and Szafran (2015), be: a sample $x_1, ..., x_n$ referring to a random variable X of a population P, $N(x)$: the number of observations less than or equal to x_n; $F(x)$: RV Cumulative Distribution Function (CDF); and $F_e(x)$: Empirical Density Function (EDF).

The purpose of the test is to verify the null hypothesis $H_0 : F(x) = F_0(x)$, for every x, that is, test whether the cumulative distribution of $X - F(x)$ matches a specified probability distribution $F_0(x)$.

It is necessary to compare the CDF of X under null hypothesis with the EDF from the realization of the difference between these functions. Asjanov and Szafran (2015) state that, given n sample points, the EDF is given by Equation 2.

$$F_e(x) = \frac{N(x)}{n} \quad (2)$$

The maximum absolute value D shall be obtained between the CDF of X, under zero hypothesis and the EDF (Equation 3).

$$D = \max |F(x_i) - F_e(x_i)|, \text{ for } 1 \leq i \leq n \quad (3)$$

The objective of the test is reached when the value found for D is compared to a critical value D_c, given by the Kolmogorov-Smirnov Distribution table - easily found in the literature - D by fixing the number n of samples and the significance level chosen. The significance level is the probability of rejecting the null hypothesis $H_0 : F(x) = F_0(x)$ if it is true, that is to say that the cumulative distribution of $X, F(x)$, does not match a specified probability distribution $F_0(x)$, when it actually matches. The significance level generally assumes values equal to 5%, 1% or 0.1%. Thus, if the value of D is less than the tabulated critical value, the null hypothesis H_0 is true, that is, the cumulative distribution matches a specified distribution. Otherwise, H_0 is rejected and therefore the parsed distribution does not match the specified distribution.

According to Asjanov and Szafran (2015), the critical value D_c for the Kolmogorov-Smirnov test, for a number of observations $n = 22$ and at 5% significance level, is 0.281.

In the literature there are several queue models, as can be seen in Fogliatti and Mattos (2007). However, due to the characteristics of the target problem of this work, the system of queues in SUS care in the pregnant and parturient sector of the hospital under study, we will present only the $M/M/1/\infty/FIFO$ model, as this is the model that represents the current situation in this sector of the hospital.

According to Bergsma (2018), in the $M/M/1/\infty/FIFO$ model, the intervals between successive arrivals and service times follow Markovian distributions, that is, these events occur according to exponential distributions, in a process of birth and death.

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This model has only one service desk and has infinite physical capacity for the queue. The service occurs according to the order of users' arrival at the system and has a constant rate, described by: $\lambda_n - \lambda, \quad \forall n \geq 0$

The system attendance rate is also constant, given by: $\mu_n - \mu, \quad \forall n \geq 1$

The parameter ρ, called system occupancy / utilization rate, is defined by Equation 4.

$$\rho = \frac{\lambda}{\mu} \tag{4}$$

Thus, in this framework two performance measures had their equations described for the $M/M/1/\infty/FIFO$ model. As presented above, there are other performance measures, however, for applicability purposes in this work, only two will be used (FOGLIATTI; MATTOS, 2007), namely:

a) Average queue time (W_q): Given by Equation 5.

$$W_q = \frac{\rho}{\mu - \lambda} \tag{5}$$

b) Average length of stay in the system (W): Given by Equation 6.

$$W = \frac{1}{\mu - \lambda} \tag{6}$$

III. METHODOLOGICAL APPROACH

The population of this study was surveyed using the sampling technique, which consists of choosing a representative part of the whole for the study, so that the results of the sample were sufficient to draw conclusions about the total population. Thus, the population of this research is formed by pregnant women and parturients users of SUS for hospitalization related to pregnancy, childbirth and the puerperium in the studied locality and region, and the sample is formed by data collected in the pregnant women care sector.

The surveyed sample consists of the people who arrive at the emergency room on a given day and time, but only the people who use the system, that is, those who arrive and receive care at the reception. Therefore, employees, visitors and service providers who pass through the pregnant women sector using it only as a route to enter the hospital are not accounted for in the sample.

The study in question is characterized by its exploratory and descriptive nature, since it is based on on-site observations with the purpose of investigating, describing and exposing the characteristics of the problem under study, as well as allowing the comparison of the existing scenario in the health sector pregnant women of this particular hospital with the Brazilian standards for pregnant women care, and thus it can be inferred whether the average waiting time in the pregnant women sector queue and the average length of stay in this sector contribute significantly to the total delay in care - ranging from the arrival of the user in the system to the doctor's care - including childbirth, prenatal examinations, etc. Thus, due to its characteristics and applied nature, it uses qualitative and quantitative approaches for diagnosis, description, discussion and comparison.

For the development of the present work, visits and data collection were made in the pregnant women care sector, with the purpose of diagnosing the current conjuncture of expectation, arrival and care of pregnant women. From this initial diagnosis, a study of Queue Theory was made in order to find a queue model that, depending on its parameters and its applicability, best represents the case in question. To find this queue model, from the data collected above, the average arrival time of customers in the queue and the average attendance rate were calculated. From these data, an adhesion test was applied - in this case the Kolmogorov-Sminorv test - as a function of the continuous characteristics of VR to verify the data adherence with the exponential distribution and, from this, to be able to identify the row model. in question, calculate their parameters - W_q and W – and then compare them with the average standards in this type of system in Brazil.

IV. APPLICATION AND ANALYSIS OF RESULTS

The queuing system studied in this paper is associated with the reception of the pregnant women service sector, as mentioned earlier. This system is delimited by the door through which users enter the reception and the door that gives access to the interior of the hospital, comprising the service window and some seats for users and companions (Figure 2).

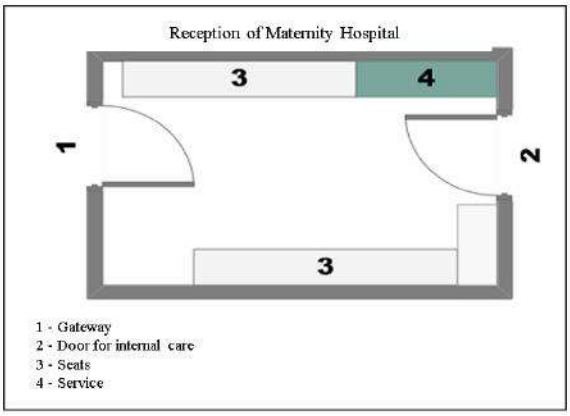

Fig 2: Physical area that served as research unit.

https://dx.doi.org/10.22161/ijaers.69.33 *ISSN: 2349-6495(P) | 2456-1908(O)*

Pregnant women arrive at the system through the reception's front door and wait for the service in line. At the counter, the service consists of checking personal documents and filling out a form with patient data. Queue discipline follows the FIFO pattern, so that service is handled in order of arrival to queue.

This research began with seeking authorization from the hospital administration in question for data collection. It was also asked the administration which would be the busiest days and times in this sector, in order to diagnose the formation of the queue. Therefore, as indicated by the administrator, the analyzed period was a Friday (4/19/2019) from 07h40min to 12h30min, encompassing the peak service - which takes place between 08h30min and 11h00min. These collection periods that demonstrate a pre- and post-peak service clearance are called pre- and post-warming, respectively, and are necessary because, according to Bergsma (2018), there is no precise method or way to establish a starting and ending point for the equilibrium state of a queued system.

Data processing began with the application of the Kolmogorov-Smirnov adherence test, to verify that the times between arrivals and service times behaved according to an Exponential distribution.

From this finding, the equations referring to Queue Theory were applied, according to section 2 of this paper. Thus, the results generated informed the current situation of the Emergency Service studied in relation to two performance measures: The average waiting time in the queue and the average user time in the system.

V. ANALYSIS OF CUSTOMER ARRIVAL PROCESS

Table 1 shows the data collected regarding the users' arrivals to the system.

Table. 1: Values involved in the Kolmogorov-Smirnov test for the arrival interval.

Patient	Arrivals Time	Interval (s)	Orderly	$F(x)$	$F_e(x)$	$\lvert F(x)-F_e(x)\rvert$
1	08:11:20					
2	08:20:29	549	31	0.0450	0.0476	0.0027
3	08:31:27	658	40	0.0576	0.0952	0.0376
4	08:39:10	463	65	0.0920	0.1429	0.0509
5	08:40:50	100	100	0.1379	0.1905	0.0526
6	08:49:13	503	132	0.1779	0.2381	0.0602
7	08:54:50	337	140	0.1876	0.2857	0.0981
8	08:57:02	132	160	0.2114	0.3333	0.1220
9	09:09:24	742	271	0.3311	0.3810	0.0498
11	09:22:35	520	337	0.3936	0.4762	0.0826
12	09:30:00	445	445	0.4834	0.5238	0.0404
13	09:30:31	31	463	0.4970	0.5714	0.0744
14	10:23:55	3204	503	0.5260	0.6190	0.0931
15	10:28:35	280	520	0.5378	0.6667	0.1289
16	10:30:55	140	549	0.5573	0.7143	**0.1570**
17	10:31:35	40	658	0.6234	0.7619	0.1385
18	11:11:05	2370	742	0.6675	0.8905	0.1420
19	11:36:05	1500	1500	0.8921	0.8571	0.0349
20	11:37:10	65	1640	0.9123	0.9048	0.0075
21	12:04:30	1640	2370	0.9703	0.9524	0.0179
22	12:07:10	160	3204	0.9914	1.0000	0.0086

Table 1 indicates that 22 clients arrived in the system during the surveyed period. Generating a rate of arrival of $\lambda = 0.0933$ clients per minute. The average interval between successive arrivals is $\alpha_1 = 673.81$ seconds.

In order to perform this test the null hypothesis is that the intervals between consecutive arrivals at the reception of the pregnant women sector correspond to an Exponential probability distribution. and with parameter $\alpha_1 = 673.81$ seconds. Equation 7 was obtained.

$$F(x) = 1 - e^{\frac{x}{673.81}}, x > 0 \quad (7)$$

Initially the values related to the intervals between

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user arrivals were ordered. From Equation 7 the values of the cumulative distribution function of $X, F(x)$ under H_0 were calculated and by Equation 2 the values for the empirical density function were calculated. With the values of the cumulative distribution function and the empirical distribution function $F_e(x)$ the absolute value of the difference between these functions was obtained. The results are shown in Table 1.

It can be seen from Table 1 that the maximum absolute value of the differences between $F(x)$ and $F_e(x)$ has the value of $D = 0.1570$ (highlighted in bold). According to values found in the Kolmogorov-Smirnov table. the critical value for the test is $D_c = 0.2810$ with 22 intervals observed. Thus. since D is less than D_c. it can be seen that the intervals between users' arrival at the system fit an Exponential distribution with parameter $\alpha_1 = 673.81$ seconds at the 5% significance level. The value of 5% was chosen for the significance level based on literature indications (FOGLIATTI; MATTOS. 2007).

Figure 3 illustrates this grip. The cumulative relative frequencies of the arrival intervals and the exponential parameter function $\alpha_1 = 673.81$ seconds are displayed.

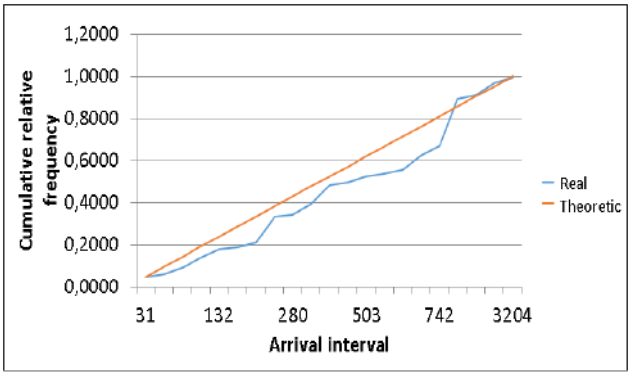

Fig. 3: Cumulative distribution of arrival interval function.

Table 2 shows the data collected regarding the users' arrivals to the system.

Table. 2: Values involved in the Kolmogorov-Smirnov test for the care of each user in the system.

Patient	Duration (s)	Orderly	$F(x)$	$F_e(x)$	$\lvert F(x)-F_e(x)\rvert$
1	156	35	0.1849	0.4545	0.1395
2	40	40	0.2084	0.0909	0.1175
3	94	60	0.2967	0.1364	0.1593
4	35	65	0.3159	0.1818	0.1341
5	190	80	0.3733	0.2273	0.1461
6	185	94	0.4225	0.2727	0.1498
7	130	100	0.4424	0.3182	0.1243
8	217	130	0.5321	0.3636	**0.1684**
9	315	133	0.5402	0.4091	0.1311
10	360	135	0.5455	0.4545	0.0910
11	264	137	0.5508	0.5000	0.0508
12	137	138	0.5534	0.5455	0.0080
13	210	140	0.5586	0.5909	0.0323
14	60	156	0.5980	0.6364	0.384
15	80	185	0.6606	0.6818	0.0212
16	100	190	0.6704	0.7273	0.0569
17	582	210	0.7068	0.7727	0.0660
18	138	217	0.7185	0.8182	0.0997
19	135	264	0.7861	0.8636	0.0775
20	140	315	0.8412	0.9091	0.0679
21	65	360	0.8779	0.9545	0.0766
22	133	582	0.9666	1.0000	0.0334

Table 2 indicates that 22 clients were served during the surveyed period. indicating a rate of attendance of $\mu = 0.3505$ clients per minute. Average answer time is

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$\alpha_2 = 171.18$ seconds.

For the performance of this test the null hypothesis is that the service times at the reception of the PS match an Exponential probability distribution according to Equation 1. and with parameter $\alpha_2 = 171.18$ seconds.

$$F(x) = 1 - e^{\frac{x}{171.18}}, x > 0 \quad (8)$$

The test was performed analogously to the interval between arrivals. The values involved are shown in Table 2.

It can be seen from Table 2 that the maximum absolute value of the differences between $F(x)$ and $F_e(x)$ has the value of $D = 0.1684$ (highlighted in bold). According to values found in the Kolmogorov-Smirnov table. the critical value for the test is $D_c = 0.2810$ with 22 observed intervals. Thus. since D is less than D_c. it can be seen that the intervals between users' arrival at the system fit an Exponential distribution with parameter $\alpha_2 = 171.18$ seconds at the 5% significance level.

Figure 4 illustrates this grip. The cumulative relative frequencies of the arrival intervals and the exponential parameter function $\alpha_2 = 171.18$ seconds are displayed.

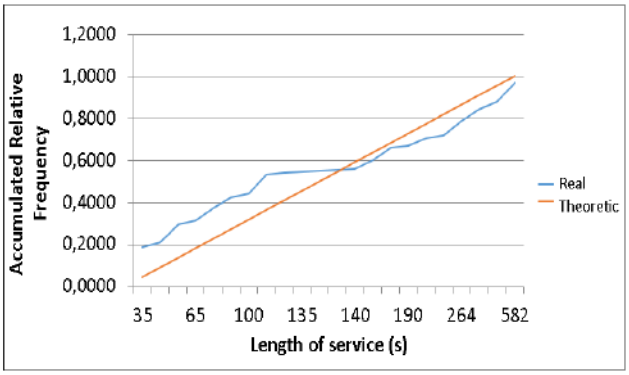

Fig. 4: Cumulative distribution function of service times.

It is important to note that it was found that the intervals between user arrivals and user service times for pregnant women are adjusted to exponential distributions. According to what was informed by the hospital management and observed in the data collection there is only one service station where customer service is received at reception and this service occurs in the order of arrival of users to the queue. In the data collection it was also noted that the queue starts at the reception desk and follows the extension of the reception room of this sector and that although the system is delimited from the entrance door to the reception desk this queue may extend beyond the door and continue on the street indicating that there is no limitation of the physical capacity of the system. Thus. it is concluded that the studied system is characterized as a $M/M/1/\infty/FIFO$ queue model.

The value found for the expected number of arrivals per unit of time $\lambda = 0.0933$ clients per minute - and the value found for the expected number of calls per unit of time $\mu = 0.3505$ clients per minute - were used in Equation 4 to calculate the system load factor – ρ. Thus. the system load / utilization rate is $\rho \cong 0.27 < 1$ indicating that 27% of the time the server is busy performing service.

VI. FINAL CONSIDERATIONS

The average waiting time in the queue (W_q) is 1.03 minutes and the average time spent in the system (W) is 3.89 minutes for the reception of the pregnant sector of the hospital under study. Therefore, the average waiting time in line and the average time spent at the reception of the pregnant women sector of this hospital are not significant when considering the entire process - from patient arrival to medical care. Therefore, in order to reduce this total time - time at reception plus internal time including hospitalization and medical care - management efforts and efforts should focus on reducing this internal time.

This study had a limitation in which different scales and compositions of medical teams were not considered in the scenario evaluation. In conclusion the service delivery system studied can be improved by reallocating available staff and also revising and modifying patient flow at no additional cost using queuing theory and simulation techniques. In other words, waiting times and patient waiting times can be reduced by using multitasking people and relocating them to the lengthy stage of filling in initial information without making any noticeable change in queuing characteristics.

ACKNOWLEDGEMENTS

Federal University of Espírito Santo (UFES)/ University Center North of the Espírito Santo (CEUNES). The Espírito Santo Research Support and Innovation Foundation - Announcements: FAPES-CNPq nº 13/2018 - PICJr; FAPES No. 21/2018 - Universal and FAPES No. 18/2018 - Researcher Capixaba Scholarship.

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Morphological studies of the composition of the Green Turtle (*Chelonia mydas*) hyoid bones found in Peruibe, Southern Coast of Brazil, Mosaic of Conservation Units Jureia-Itatins

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Abstract— *Chelonia mydas, popularly known as the green turtle, is widely distributed in tropical seas and uses as its feeding area the coastal region of Peruíbe, located on the southern coast of São Paulo State. It has a solid cranial formation, without temporal openings and formed by the junction of several small bones, among them the hyoid bones that have the function of supporting the tongue. In a study conducted with 10 individuals of the same species and with similar sizes, the objective was to verify the presence of a differentiated bone structure that has not been described in any study until the present moment and to verify if it was not only anatomical variation generated by any anomaly. in the evaluated animals. The techniques used for verification were computed tomography (with window for bone parts: center - WL 300 and width - WW 1,500) and histological analysis. For histology, the hyoid bone structure was removed from the skull separation and disarticulation and tongue extraction. With the separation of the bones, cuts of approximately 0.5 cm in length were made and fixed in 10% paraformaldehyde, with subsequent application of the fixation procedure, for observation with scanning electron microscopy. The structure analyzed was identified in 6 individuals. This proves that it is part of the formation of the hyoid bone, so it is necessary to name this structure and carry out in-depth studies to know its importance and to verify if it is a modification that is affecting the species or if it is a genetic variation that affected population studied.*

Keywords— keratobranchial process II; morphology; scanning electron microscopy; tomography.

I. INTRODUCTION

The *Chelonia mydas* (1) popularly known as the green turtle has wide distribution in tropical seas, usually between 40ºS and 40ºN (2). It uses as food area the coastal region of Peruíbe, located on the south coast of São Paulo that is within the areas of the Cananéia-Iguape-Peruíbe Conservation Units, Jureia-Itatins Conservation Units Mosaic and Tupiniquins Ecological Station. (3).

According to the latest IUCN (Red List of Threatened Species) assessment in 2004, the conservation status of the species Chelonia mydas (Family Cheloniidae) has category A2bd, which classifies the species as endangered, based on information on population reduction (4). With the increasing decline in the number of individuals, studies are needed to assist in the health of these animals when found / caught, whether intentionally, incidentally, or stranded both alive and dead. These individuals may be affected by various diseases involving the cranial region, such as meningeal hemorrhage, spinal cord compression, traumatic injuries associated with fishing activities, ingestion of hooks and lines, eye fibropapillomas, among others (5)(6).

https://dx.doi.org/10.22161/ijaers.69.34 ISSN: 2349-6495(P) | 2456-1908(O)

Unlike other reptiles, the sea turtle has a solid skull, without temporal openings and formed by joining several small bones. It is made up of the neurocranium that provides the lining shell for the brain and the esplanocranium which is made up of the bones that cover the face. Anatomical variation that promotes bone shape is characteristic for each species (7).

The green turtle has a cranial shape consisting of a short rounded muzzle lined with keratin and parietal bones with shallow carvings. They have a sturdy jaw, the upper one having a smooth U-shaped contour and the lower jaw having a ridge parallel to the interior surface and a midline cusp. The palate is present between the upper jaw margins and the inner nostrils (alveolar surface), has a pair of mountain ranges that occur parallel to the outer edge of the mandible. In addition, it has a horned or ranch-shaped beak that covers the maxillary, premaxillary, and vomer bone of the upper jaw, and the lower jaw dental, and present the hyoid bone, which has the function of supporting the tongue (8).

Computed tomography (CT) is a noninvasive imaging diagnostic method that has been the focus of research to develop new study and treatment methods to assist in the conservation of sea turtle species, as can be cited for use in rehabilitation Due to its high sensitivity, it allows the visualization of various organs, providing information on its shape, as well as the characterization of small alterations. In addition, it is possible to provide information on bone morphology, consequently allowing the acquisition of biomechanical parameters, as it characterizes loss of bone mass (9)(10).

It is widely used to detect skeletal and soft tissue disorders in turtles (11). This is because turtles exhibit changes in bone mineral metabolism regardless of whether they are free-living or captive animals (12)(13)(14).

CT has been used to study the embryonic development of these animals, according to Kuratani (15) who describes the development of the chondrocranium of *Caretta caretta* species. In the early stages of embryonic development, the morphology of bird and reptile embryos resembles that of a shark embryo, as does the initial pattern of mesenchymal condensation seen in mammalian skulls. Thus, reptiles can serve as a useful model system for understanding the development and evolution of the amniotic skull. They exhibit a set of primitive features that are characteristic of amniotes such as an extensively chondred neurocranium composed of paracordal cartilage and broad orbital cartilage that surrounds the neural tube (16).

In the application of the CT technique in the chondrocranium region of juvenile turtle juveniles, the presence of a bone structure that was not previously described was observed, and there are no studies related to the observation of sequential morphological changes in the hyoid bones of these animals. regardless of their stage of growth. Therefore, it will be necessary to study the morphology of the Chelonian hyoid to discover the function of this new structure found only in this species (*Chelonia mydas*).

The aim of the present study was to describe and name a new bone structure (keratobranchial process II), located in the 2nd branchial horn of the hyoid.

II. MATERIAL AND METHODS

We used 10 individuals of the species Chelonia mydas, found dead within the Environmental Protection Area - Cananeia-Iguape-Peruíbe and Cananéia-Iguape-Peruíbe Conservation Units, Mosaic of Jureia-Itatins Conservation Units, collected by the SOS Tartarugas Project, with license. Tamar / Icmbio-50132, authorization of the Ethics Committee No. 003/19 - CEUA IBIMM and donated to FMVZ, and approved by CEUA FMVZ – USP No. 3829270117 of 03/15/2017.

The animals were taken to the radiology and tomography center of the University Hospital of the University of São Paulo, where they diagnosed the images using the Philips Brilliance CT Scanner, 64 rows of detectors. Cutting Thickness: 1mm. Windows were obtained for soft tissue and bone tissue. Soft Part Windows: Center (WL 60) and Width (WW 400), Bone Part Windows: Center (WL 300) and Width (WW 1,500), Flat Reconstructed Cuts: Axial, Coronal, and Sagittal. The Volumetric Reconstruction Technique was designed with Volume Rendering and the computer programs used for visualization and capture were done through Philips Workstations and Radiant DICOM Viewer. For the hyoid bones only windows for bone parts were used (HU-University Hospital-Center of Radiology-USP).

The procedures for macroscopic analysis include the separation and disarticulation of the skull, with cuts made with the aid of a scalpel, sectioning the skin and musculature, for access to the tongue. After removing the tongue from the samples, the musculature and cartilage of the tongue were separated until the hyoid bone structure was located (17).

The samples were cut into approximately 0.5 cm long sections and fixed in 10% paraformaldehyde, dried in a Balzers CPD 020 critical point apparatus (CADI-FMVZ-USP), glued with carbon glue on aluminum metal bases (stub). and sputting with gold on the EMITECH K550 (FMVZ-USP) metallizer, and subsequently analyzed and photographed on a LEO 435VP scanning electron microscope (FMVZ-USP) (17).

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III. RESULTS AND DISCUSSION

The animals had an average body mass of 5.4 kg and values of carapace curvilinear length (CCC) 38.05cm and carapace curvilinear width (CCL) 34.95cm, the individual measurements are shown in table 1.

Table 1 - Biometric data of green turtles.

INDIVIDUALS	CCC (cm)	LCC (cm)	BODY MASS (Kg)
01	40	35	6,5
02	36	32	4,5
03	26	25	1,6
04	38	36	5,5
05	44,5	39,5	7,8
06	33	31	3,9
07	37,5	33	4,5
08	44	41	5,2
09	41,5	39	7,6
10	40	38	6,9

Source: WYNEKEN, (2001) p. 28

Anatomy is of great importance in wild veterinary medicine, most of the findings were based on the techniques of dissection and study of the bones of various animals, which contributes a lot to the morphological sciences. In the case of sea turtles, mainly *Chelonia mydas* species, there is no complete anatomical atlas, being used only as reference the works restricted to the production of complementary scientific articles. In this work, the anatomy and dissection techniques contributed to the discovery of a new structure, besides using computed tomography as an important research aid tool.

During the anatomical evaluation process of the skull bones of a green turtle (*Chelonia mydas*) individual, the presence of a new anatomical structure was observed and according to a bibliographic survey, it has not been cited in any world literature until the present moment, which generates the need to discuss a new nomenclature for it.

To verify its presence, the study was conducted with other animals, totaling ten individuals, through the computed tomography procedure in the skull region (Figure 1) and to verify if it was not only anatomical variation generated by any anomaly in the evaluated animal, 9 more individuals were dissected whose hyoid bones were evaluated. The animals evaluated were of the same species and with similar sizes.

Among all individuals analyzed, the structure was found in 6 individuals. Which proves that it is part of the formation of the hyoid bone. The bone composition of the hyoid apparatus follows in figure (2).

Fig.1 *- 3D computed tomography of the green turtle skull (Chelonia mydas). Figures I, II and III - yellow circle, presence of the new structure. Caption: In (A): I - anatomical section for removal of the hyoid bone, I - keratobranchial I, II - hyode body, III - keratobranchial II. in (b):, IV- horned beak, II - tongue, III - keratobranchial musculature. in (c): VII -lingua, VIII-hyoid paraparate (keratobranchial I or horn I), IX-keratobranchial II (horn II). in (d): X - body of the hyode, XI - keratobranchial I, XII - keratobranchial. in d, e, f (circle) keratobranchial process II.*

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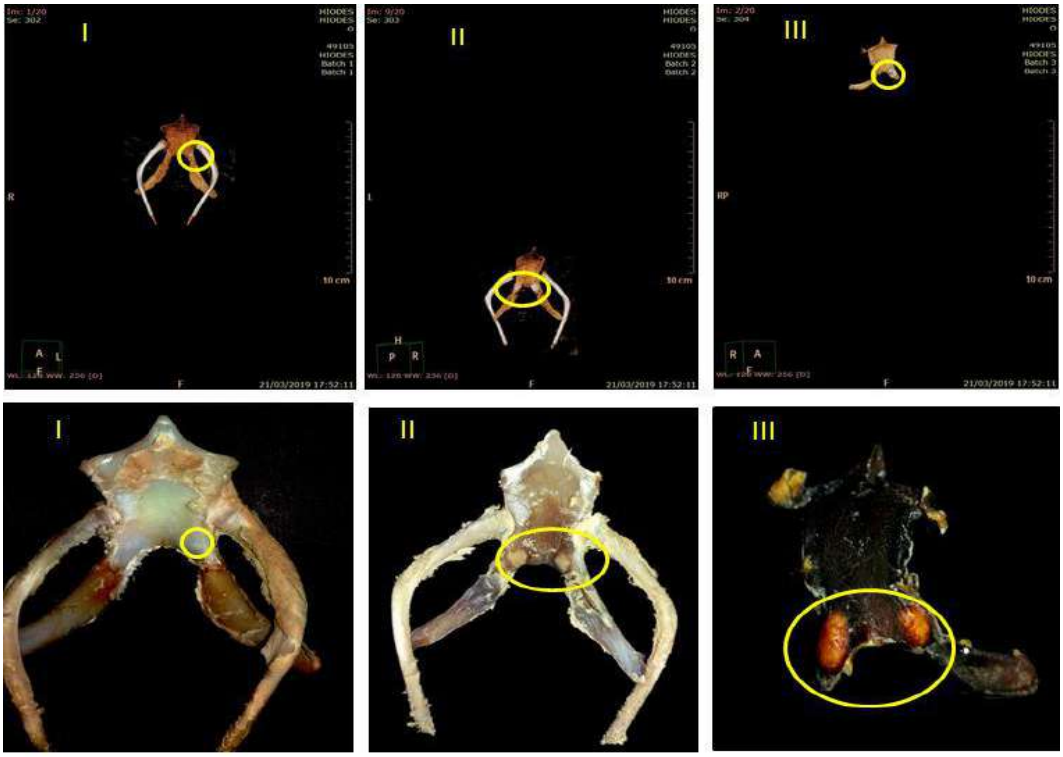

Fig.2: Computed tomography of the bone structure present in the green turtle hyoid. It is observed in the upper figure in I, II and III (yellow circle) the presence of white bone, orange cartilage. In the lower figure, photographs of the hyoid bone, in I, II and III (circles) presence of bone structures. Processed in a CT scanner at the Radiology Center of the University Hospital of the University of São Paulo.

In computed tomography it was possible to prove that the structure is a bone. Layers define a different composition of structures and coloring. It is possible to visualize the porous layers of the bones according to figures 3 and 4.

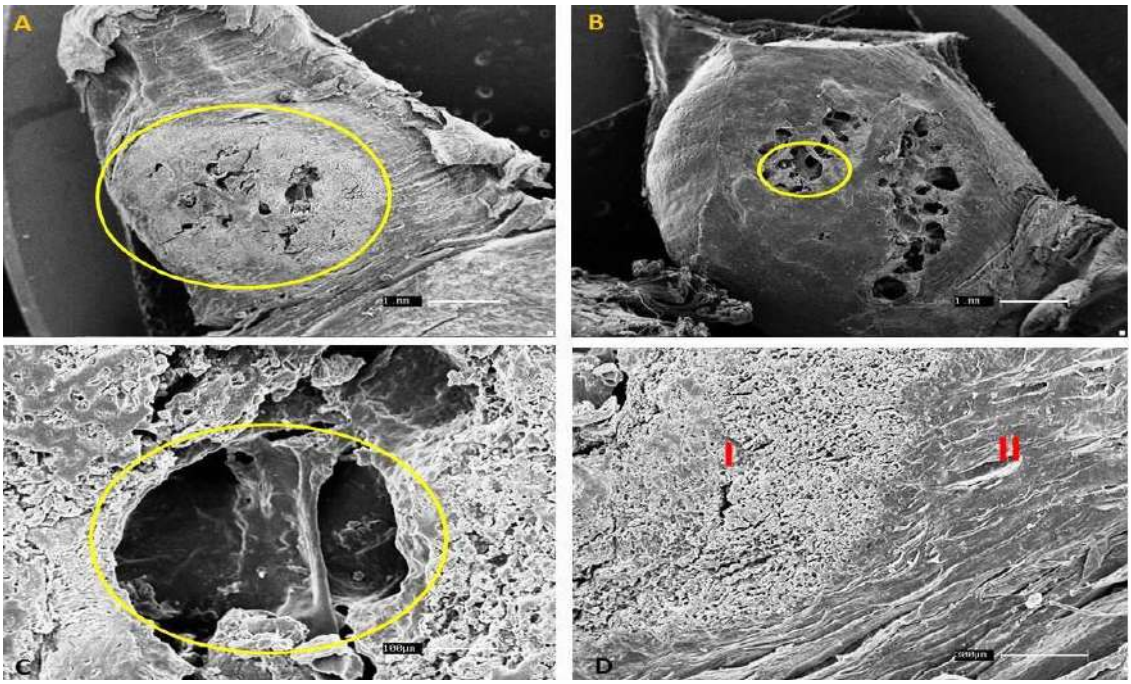

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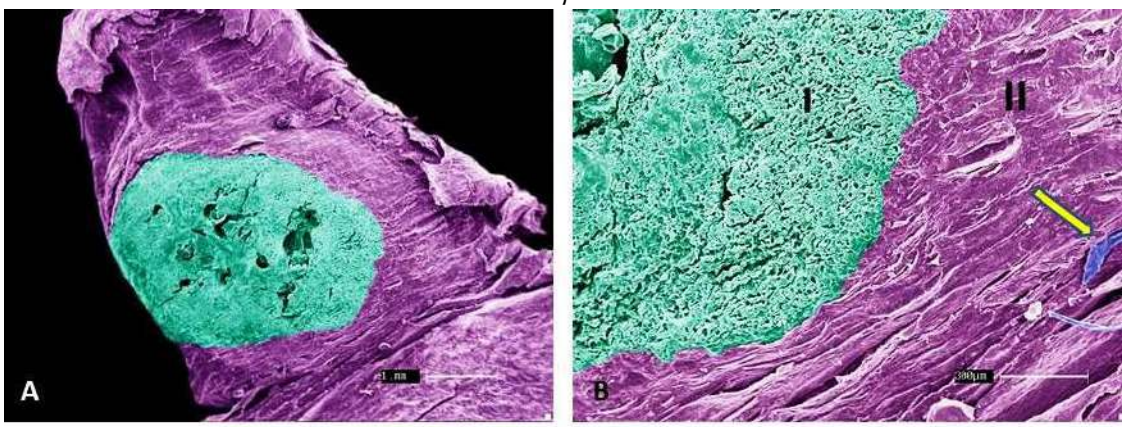
Fig.3: Computed tomography of the keratobranchial process II; In A (yellow circle) calcified bone, 1µm increase; in B - Circle (pores) 1µm increase; in (C) porous channels, 100µm increase; in (D) I - bone structure, in II - cartilage-increase of 300µm.



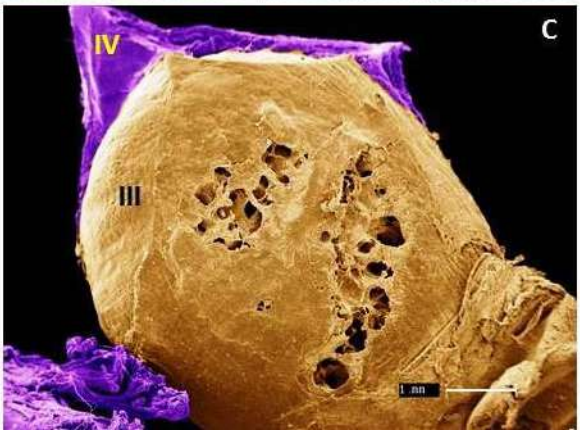


Fig.4: Scanning electron microscopy of the new color structure. Note (A) green (calcified bone and cartilage violet) 1µm increase; in (B), I - calcified bone, II - cartilage, arrow (muscles) increase of 300µm; and in (C) III - bone calcified with pores, IV - cartilage - 1µm increase.

In works by Kuratani (16)(18)(19) describes cranial morphology and development of the hyoid in the skull of Caretta caretta species, but did not present at any stage of developmental stages (from embryo to adult animal) the appearance of the observed structure. on green turtles.

Other authors such as Werneburg *et al.* (20), Garcia *et al.* (21), Jones *et al.* (22) describe the skull and hyoid bone of *Caretta caretta* and *Lepdichoelys kempi* turtles with computed tomography technique; Wyneken (8) described the anatomical part from dissection and Arencibia *et al.* (23) describe the skull of the species Caretta caretta from computed tomography and also did not observe the presence of the structure present in the hyoid bone apparatus, located in the second gill horn or keratobranchial bone II, of the green turtle.

Work (24) and Wyneken (8) cite in their work peculiar changes in green Hawaiian tortoises, such as the emergence of a new structure called (esophageal diverticulum or crop), the function of which has not yet been confirmed. This structure is found only in green turtles in the Caribbean regions and also in some individuals in South America.

IV. CONCLUSION

Veterinary anatomy and osteology are essential study tools to develop and expand the knowledge about marine animals that are necessary to understand the life dynamics of these organisms and therefore have data to use for their conservation. At the first moment it is very important to characterize this structure and name it "keratobranchial process II". Defining the importance / function of the bone discovered in the green turtle may help in understanding the eating habits of these animals, which is completely different from other species of sea turtles, so perhaps not yet described or found in them, as well as verifying if it is. a modification that is affecting the species or if it is a genetic variation that affected the population studied This opens a new door to study the function of this structure and why it does not appear in all green turtles.

https://dx.doi.org/10.22161/ijaers.69.34 *ISSN: 2349-6495(P) | 2456-1908(O)*

ACKNOWLEDGEMENTS

Thanks to the Advanced Center in Diagnosis by Image – CADI -FMVZ / USP.

CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest.

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https://dx.doi.org/10.22161/ijaers.69.35 *ISSN: 2349-6495(P) | 2456-1908(O)*

Scientific Prospecting on Sustainable Development: A Bibliometric Analysis

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Abstract*—This study aimed to map a scientific production on Sustainable Development through a bibliometric analysis. The methodological procedures were delineated by a quantitative approach, the research involved data taken from Scopus scientific database. For the searches in this database, the keywords "sustainable development" and "sustainable development" were used within a period of 10 years, from 2009 to 2018. The searches identified 7,841 publications related to the theme, an average of 784 articles published per year.The year with the largest number of publications was 2018, with 1279 publications. The author with the largest number of publications was researcher Razman, M. R., with 17 articles published.Regarding the areas of publication of articles, the ones that stood out in relation to the number of articles published were: Social Sciences, Environmental Science, Energy, Business, Management and Accounting and Engineering, with respectively 3,844, 3,051, 1,551, 1,398 and 1,093 articles. published. Among the journals, the ones with the highest number of publications were: Sustainability Switzerland, Journal of Cleaner Production, Sustainable Development, with respectively 391, 186 and 145 publications. Regarding educational institutions, the highlights regarding the number of articles published were for the Chinese Academy of Sciences, The Bucharest University of Economic Studies and University Kebangsaan Malaysia. The country with the largest number of publications in the area - United States, with 850 publications. Note that most of the publications were written in English, with a total of 7,091 publications in English.*

Keywords**—Bibliometrics, Scientific Production, Sustainable Development.**

I. INTRODUCTION

Growing concern about excessive resource consumption, environmental degradation and social inequality has resulted in calls for a transition to a more sustainable society and economy. It was in the subsequent work of the World Commission on Environment and Development Brundtland Report (Brundtland, 1987) that the concept of development being one that meets the needs of the present without compromising the ability of future generations to meet their own needs, becoming a conventional concept for literature (ADAMS et al., 2016).

Since the mid-twentieth century, numerous environmental, social and economic crises on a global scale have significantly affected our societies. (TRINDADE et al., 2017). The concept Sustainable Development is increasingly in the political debate, academic discussions and practically all layers of society (STOFFEL; COLOGNESE, 2015).

Therefore, this research aimed to analyze the academic scientific production related to the area of Sustainable Development in the last 10 years (from 2009 to 2018), providing researchers and the academic community with an overview of scientific and technological studies and advances in this area. over that period.

This article is divided into five sections. The first section provides an introduction to the topics covered in this research. The second section presents a brief review of the literature related to bibliometrics and sustainable development. The third section shows the methodology used in the development of this research. The fourth section presents the analysis of the data obtained in the

https://dx.doi.org/10.22161/ijaers.69.35 *ISSN: 2349-6495(P) | 2456-1908(O)*

research. The fifth section brings the final considerations on the research.

II. REVIEW OF LITERATURE

Sustainable Development

Sustainable Development has become an ideal, a new paradigm for today's society and its concept has spread throughout society (STOFFEL; COLOGNESE, 2015). This concept emerged from a process of critical reevaluation of the relationship between the economy, society and the environment (RODRIGUES; RIPPEL, 2015).

According to Sheng (2001), to achieve Sustainable Development, it is necessary to move towards a comprehensive conception, understanding the very concept of the term and, at the same time, extending this understanding to the agents and actors involved in society in a clearer way. According to Weil (2002), individuals will be able to discern their true responsibilities if they reflect on problems that have made critical the natural processes of the earth such as: excessive consumption, abuse of the environment, aggression among people, for example.

For Oliveira and Santos (2015), sustainable development is a variable in the process of approximation of the long-term sustainability condition. Costa (2015) believes that sustainable development includes social justice, income distribution, full employment, security and health in the workplace, environmental protection and socioeconomic well-being.

Thus, development must be understood as "a complex process of economic, political and, mainly, human and social changes and transformations" (OLIVEIRA, 2002, p. 40). The concept of sustainable development has undergone several transformations: perception of environmental degradation, environmental problems understood as a general phenomenon without territorial limits of National States, degradation as a planetary problem that harms everyone, and is linked to the type of development practiced (BARBIERI, 2000).

For this work, sustainable development is understood to be that definition of the report of the World Commission on Environment and Development Brundtland (Brundtland, 1987): “one that meets present needs without compromising the ability of future generations to meet their own needs”.

Bibliometrics

According to Silva et al. [14] "The term bibliometric is derived from the fusion of the suffix "metric" with bibliography, information, science and library respectively, are analogous or very close in nature, objectives and applications."

Bibliometrics as a method has the advantage of softening the elements of judgment and generating quantitative results that tend to be the sum of many small judgments and judgments made by several people (SANTOS; RAUSCH, 2009). Bibliometric studies serve to evaluate the productivity and research quality of scientists by measuring based on the number of publications and citations of various researchers (VANTI, 2002).

Bibliometric research allows the identification and description of a series of patterns in the production of scientific knowledge. In addition, it serves to estimate with quality and quantity, the production of scientific articles published on a particular theme, highlighting the main authors (researchers and institutions) involved in this process, which contribute to the enhancement of science (BASTOS; HEIN; FERNANDES, 2006).

Traditionally, bibliometric studies are developed from information obtained from large databases, such as: Web of Science, Scopus, Scielo, ACM, IEEE, among others.

III. METHODOLOGY

The methodology used in this research had a quantitative and descriptive character, which initially had a bibliographic survey on the themes bibliometrics and Sustainable Development, conducted through research in scientific articles, dissertations, theses, seminars and periodicals in the area.

According to Cervo, Bervian and Silva (2007), the method is concretized as a set of several steps or steps that must be followed to perform a research and that configure the techniques.

Then, bibliometric researches were performed in the Scopus scientific production database, based on articles published in indexed congress journals and annals, related to the theme sustainable development. The time frame used in this research comprised the period from 2009 to 2018.

Bibliometric research is widely used to quantify the processes of written communication related to a particular theme (SAES, 2000).

The quantitative technique seeks the theoretical basis in the bibliometric laws and principles, detailing and outlining the paths that must be crossed to map the scientific production (VIEIRA; HORI; GUERREIRO, 2008). Filho, Junior and Siqueira (2007), state that the principle of bibliometrics is to analyze scientific activity through the quantitative study of publications.

Bibliometric studies also allow the measurement of the content of theses, articles published in annals and journals,

https://dx.doi.org/10.22161/ijaers.69.35 *ISSN: 2349-6495(P) | 2456-1908(O)*

among others, through analyzes referring to the authors, citations and methodology (BARBOSA et al., 2008). The bibliometric research developed in this work had the following process steps: definition of the research theme; choice of database; elaboration of search criteria; data collection and analysis of search results.

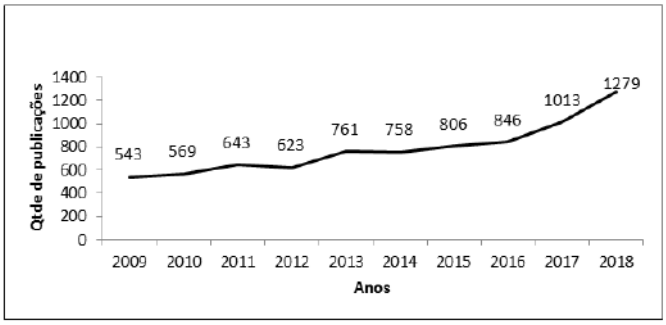
Regarding the search criteria used in the academic production databases, keywords entered in the "title" field of the database cited were used, obeying the time interval established by the research, from 2009 to 2018. The keywords used in the survey were: "sustainable development" and "sustainable development".

After collection, the data were transported to a spreadsheet, where they were processed, organized and tabulated, generating statistical graphs referring to bibliometric indicators related to the theme addressed in this research.

IV. DATA ANALYSIS

Graph 1 shows the volume of articles involving the theme "sustainable development" published in the Scopus platform database, from 2009 to 2018.

According to the collected data, 7,841 publications were identified over the analyzed period (10 years). This is equivalent to an average 784 articles published per year. These numbers show that studies in this area have grown over the years, arousing the interest of researchers and institutions on the subject.



Graphic. 1: Number of publications entitled Sustainable Development in the Scopus database. Prepared by the authors (2019).

Table 1 shows the authors with the highest indexes of publications related to the theme sustainable development in the Scopus database within the analyzed period.

Table. 1: Authors with the highest index of publications on the theme "sustainable development" in the Scopus database. Prepared by the authors (2019).

AUTHORS THAT PUBLISHED MORE	NUMBER OF PUBLICATIONS
RAZMAN, M.R.	17
ARIFIN, K.	12
KOPNINA, H.	12
TVARONAVIČIENE, M.	10
RAMLI, Z.	9
BERAWI, M.A.	8
GERICKE, N.	8
HUANG, G.H.	8
DUDIN, M.N.	7
HAPPAERTS, S.	7

The highlight regarding the amount of articles published is for the researcher Razman, M.R., with 17 articles published.

Table 2 shows the most comprehensive areas of articles published on the theme sustainable development in the Scopus database. The number of publications stood out in the areas of Social Sciences, Environmental Science, Energy, Business, Management and Accounting and Engineering.

Table. 2: Areas with the most publications on sustainable development in the Scopus database. Prepared by the authors (2019).

AREA	NUMBER OF PUBLICATIONS
Social Sciences	3844
Environmental Science	3051
Energy	1551
Business, Management and Accounting	1398
Engineering	1093
Economics, Econometrics and Finance	927
Agricultural and Biological Sciences	643
Earth and Planetary Sciences	427
Arts and Humanities	320
Medicina	313

Table 3 shows the journals that had the largest number of articles published on the theme sustainable development in the Scopus database. Highlights regarding the number of articles published were for the journals: Sustainability Switzerland, Journal of Cleaner Production, Sustainable Development.

https://dx.doi.org/10.22161/ijaers.69.35 ISSN: 2349-6495(P) | 2456-1908(O)

Table. 3: Journals with the largest number of publications on the theme "sustainable development" in the Scopus database. Prepared by the authors (2019).

PERIODICS / MAGAZINES	NUMBER OF PUBLICATIONS
SustainabilitySwitzerland	391
Journal of Cleaner Production	186
Sustainable Development	145
ProblemyEkorozwoju	134
Quality Access to Success	116
Wit Transactions on Ecology and the Environment	94
International Journal of Sustainability in Higher Education	71
Journal of Security and Sustainability Issues	71
Business Strategy and the Environment	58
International Journal of Sustainable Development and World Ecology	54

Table 4 shows the educational institutions that stood out in relation to the volume of articles published in the area of sustainable development.

The highlight of the number of publications was the Chinese Academy of Sciences, The Bucharest University of Economic Studies, Universiti Kebangsaan Malaysia.

Table. 4: Educational institutions with the largest number of publications on the theme "sustainable development" in the Scopus database. Prepared by the authors (2019).

INSTITUTIONS	NUMBER OF PUBLICATIONS
ChineseAcademyofSciences	105
Academy of Economic Studies, Bucharest	58
The Bucharest University of Economic Studies	57
UniversitiKebangsaanMalaysia	55
WageningenUniversityandResearch Centre	48
VilniausGediminotechnikosuniversitetas	44
Utrecht University	39
Kazan Federal University	38
CNRS Centre National de laRechercheScientifique	35
Tsinghua University	34

Table 5 shows the countries that had the largest number of publications on sustainable development in the Scopus database. The ranking of the five countries with the highest number of publications is led by the United States, followed by China, the United Kingdom, India and Germany.

Table. 5: Countries with the most publications on sustainable development in the Scopus database. Prepared by the authors (2019).

COUNTRIES THAT PUBLISHED MORE	NUMBER OF PUBLICATIONS
United States	850
China	800
United Kingdom	641
India	364
Germany	361
Russia Federation	355
Australia	344
France	316
Romania	306
Poland	288

Regarding the language of publications, Table 6 shows that the highlight is the English language, given the universality of this language. In addition to publications in the English language, there are also publications in several languages, which shows that the theme sustainable development has a worldwide reach, arousing the interest of researchers worldwide.

Table. 6: Languages with the largest number of publications on the theme "sustainable development" in the Scopus database. Prepared by the authors (2019).

LANGUAGE MOST USED	NUMBER OF PUBLICATIONS
English	7091
French	178
Spanish	134
Chinese	130
Russian	118
Polish	102
German	98
Portuguese	85
Ukrainian	36
Lithuanian	28

Figure 1 was produced from the use of CiteSpace software, which allows the visualization of patterns of relationship

https://dx.doi.org/10.22161/ijaers.69.35 *ISSN: 2349-6495(P) | 2456-1908(O)*

between topics, enabling the identification of moments of themes explosion and the evolution of research fronts.

Figure 1 illustrates the most frequent keywords in the title and summaries of scientific productions related to the theme sustainable development.

Fig.1: Top Keywords in Sustainable Development Publications " in the Scopus database. Prepared by the authors (2019).

V. CONCLUSION

This research shows a study of the scientific productions related to the theme sustainable development in the scientific database Scopus, in the time frame of 10 years (2009 to 2018).

The bibliometric study serves as an important scientific research mechanism that shows the evolution of this technology in the world over the period investigated.

Measurement of scientific production through bibliometrics allows the performance of researchers, institutions, countries and journals to be evaluated through mapping scientific articles and other scientific productions, taking into account quantitative and qualitative metrics.

All articles identified in this research were analyzed according to the following criteria: authors, areas of knowledge, journals in which they were published, authoring institutions, countries that had published the articles and languages that were written.

Through this study, it is expected to have contributed to the evolution of the researched theme, and that the results of this research may benefit researchers and scholars in the area, arousing interest in new studies in this technological area.

For future work, this study proposes the use of other scientific research databases and the use of new keywords related to the theme.

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https://dx.doi.org/10.22161/ijaers.69.36 *ISSN: 2349-6495(P) | 2456-1908(O)*

The Use of Seismic Refraction and Geotechnical Parameters to Conduct Site Investigation – A Case Study

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Abstract— *Due to the disastrous effects of building collapse in recent years as a result of improper site investigation, the site for a multi-purpose storey building at New Atuabo in Tarkwa, Ghana was investigated using seismic refraction and some geotechnical parameters. The results for the seismic refraction revealed that there are four strata. The site has a top soil of 1.5 m thickness and second layer made of 8 m thick weathered material. The third and fourth layers being saturated material and bedrock respectively have vertically extensive depths. The seismic refraction also showed an average depth to water table of 9.5 m. The geotechnical tests conducted were Dynamic Cone Penetration Test (DCPT), Sieve Analysis and Atterberg's Limit Test. DCPT was conducted to estimate the bearing capacity of the soil. The safe bearing capacity was 294 kN/m^2 at a depth of 2.2 m. Sieve analysis results showed that the soil is well graded. And finally, Atterberg's Limit Test was conducted to know the plastic nature of the soil. This yielded an average plasticity index of 7.75 %, which means the soil is silty with low plasticity. The plasticity index was used to estimate the swelling potential of the soil and was found to have a low swelling potential.*

***Keywords*— site investigation, seismic refraction, bearing capacity, plasticity index.**

I. INTRODUCTION

A multi-purpose storey building is to be put up at New Atuabo in Tarkwa, Ghana. With the information of a building collapse in the past due to improper or lack of site investigation, the owner contacted some people from the Department of Geological Engineering of the University of Mines and Technology to conduct the site investigation in order to ascertain the safety of the auditorium.

Buildings need firm and competent foundations to be able to last. Some soils are problematic and adversely affect the foundations of structures thereby compromising the stability of the structures. These soil problems have resulted in excessive settlement, tilting and collapse of many buildings not only in Ghana but also around the world (Katzenbach *et al.*, 2005). A study conducted in Ghana shows that between the year 2000 and 2016, there were reported cases of eight buildings that collapsed in Greater Accra Region, five in Ashanti Region and one in BrongAhafo Region with twenty-six deaths, two missing people and several people sustaining various degrees of injuries. The report also captured the collapse of an uncompleted five-storey hotel building in Tarkwa, Western Region on January 31, 2010 which killed 3 people (Asante and Sasu, 2018).

Geophysics and geotechnical investigations are very useful in site investigations. Seismic refraction method is one of the most commonly used geophysical methods for site investigation and has been employed by many engineers and geoscientists to investigate the subsurface conditions of construction sites such as overburden and litho-stratigraphy, depth of water table and the discontinuities of the subsurface among others (Rucker 2000; Rucker and Ferguson, 2006). Geotechnical investigations are also conducted to describe the nature, subsoil property, soil bearing capacity, soil index property and settlement capacity of the soil and to predict and solve potential foundation problems including ascertaining the suitability

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of the soil at the construction site among others (Arora, 2004).

II. LOCATION AND GEOLOGY OF STUDY AREA

New Atuabo is a suburb of Tarkwa, the capital of Tarkwa Nsuaem Municipality, in the Western Region of Ghana. It is accessible by road about 322 km from Accra. Tarkwa is hosted on the unconformable contact between younger Tarkwaian rocks to the west and Birimian rocks to the east. The Birimian rocks consist of penecontemperaneous low-grade sedimentary and volcano-clastic rocks (Eisenlohr and Hirdes, 1992). The sediments have been metamorphosed to lowgrade green schist facies and are commensurate with braided stream environment (Kesse, 1985). The Tarkwaian Group comprises a sequence of coarse, clastic, fluviatile meta-sedimentary rocks consisting of the Kawere conglomerates.

Banket Series (host of gold mineralisation), Tarkwa Phyllite and Huni Sandstone. About 20 % of the total Tarkwaian within the Tarkwa area is made up of intrusive igneous rocks, which form conformable to slightly transgressive sills with small number of dykes. The Tarkwa area is faulted and jointed with the most prominent joints trending in *WNW* to *ESE* direction (Hirdes and Nunoo, 1994). New Atuabo area is predominantly underlain by Kawere Conglomerate and the Birimian.

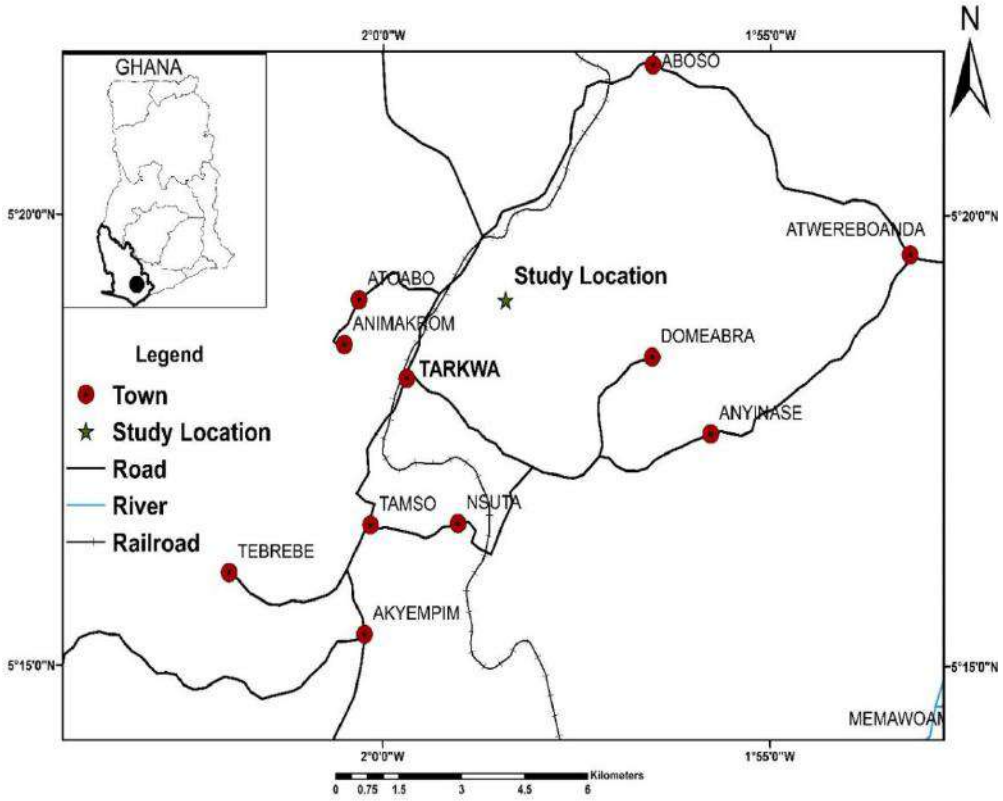

Fig. 1 Map of Tarkwa showing Study Location

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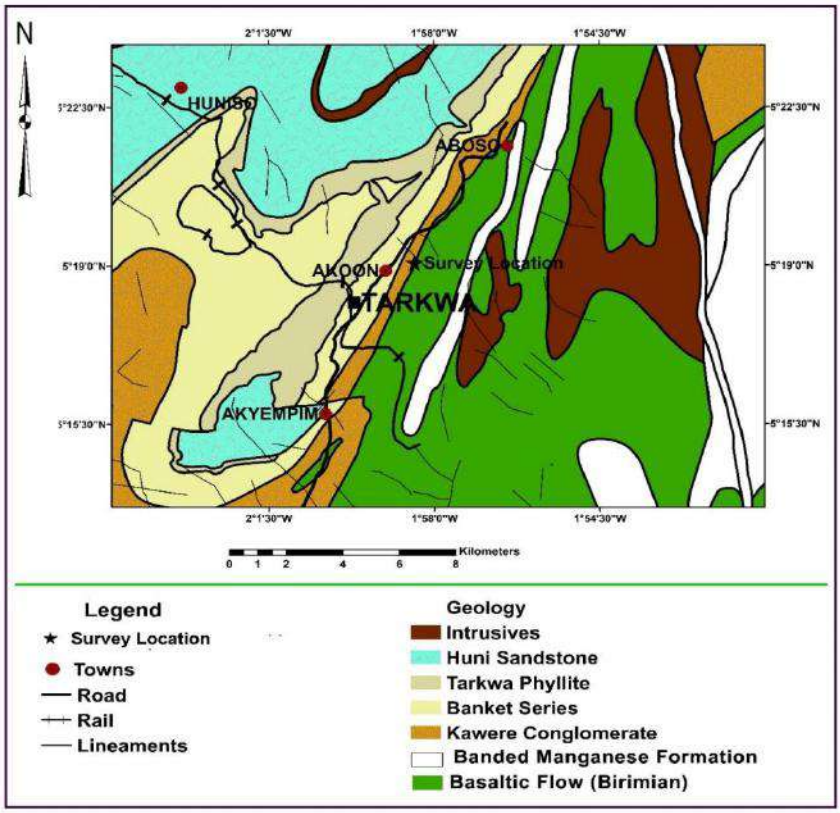

Fig. 2 Geological Map of Study Location

Table 1 Stratigraphic Succession of the Tarkwaian System

Series	**Thickness (m)**	**Composite Lithology**
Huni Sandstone (and DompimPhyllite)	1370	Sandstones, grits and quartzite with bands of phyllites.
TarkwaPhyllites	120 – 400	Hunisandstone transitional beds and green chloriticand sericiticphyllitesand schists.
Banket Series	120 – 160	Tarkwaphyllitetransitional beds and sandstones, quartzites, grits, brecciasand conglomerates.
Kerewe Group	250 – 700	Quartzites, grits and phyllitesand conglomerates

III. PROCEDURES

3.1 Field Works

Seismic Refraction Survey

The seismograph equipment was used to measure seismic waves. Geometric ES-3000 seismograph was used for the seismic data collection. The set up was made up of a seismograph, 60 m spread cable, 12 geophones, a sledge hammer and a metal striker plate. Two seismic refraction profiles were acquired across the study area. Stack of three (3) shots was used at various shot locations on a profile to minimize background noise effect and to increase signal to noise ratio. For each profile, the geophone interval was 5 meters and had seven shot points. A sampling rate of 62.50 µs with recording length of 0.25 s was used. Moreover, a low cut filter of 15 Hz was used to filter noise frequency from traffic and a notch filter of 60 Hz was used to filter frequency noise from power lines.

The geophones were firmly inserted into the ground and kept as vertical as possible to achieve best connection of the seismic signal with the geophones. Lower frequency geophones in particular tend to have loose sensitivity if they are not vertical. To achieve maximum signal connection,

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loose materials were cleared before placing the striker plate on the ground. The sledgehammer was prevented from bouncing on the striker plate when stricken, to avoid false trigger from occurring.

The first step in the data processing is to pick the first arrivals. This was done with Pickwin, a software designed by Geometrics to be used to pick first arrivals from seismograms. The first breaks were picked automatically and adjusted manually, to achieve high accuracy in the travel times.

The next step was to assign layers to the travel times, which were picked with the Pickwin software. This was done with the aid of Plotrefa, which is a seismic refraction analysis software produced by Geometrics. This arrival time picks are used to plot the travel time curves from where the velocity layers can be estimated from the reciprocal of the slopes obtain from the plot. After the layer assignment, an initial velocity model is estimated using time-term inversion. In this case, a two or three velocity layer model is represented by the results obtained from the simple interpretation of the travel time plot from the seismic refraction data. Tomographic inversion is then generated from the initial velocity model after some number of iterations are completed. After each iteration, ray tracing is initiated to produce a calculated travel time curve. The difference between the calculated and the observed travel times is shown as the RMS error. The rule of thumb is that, the smaller the RMS error, the higher the accuracy of the data. The iterations for the tomographic inversions are stopped when the RMS error reduces to a minimum value, where further iterations results in no change in the RMS error.

Dynamic Cone Penetration Test

Dynamic Cone Penetration (DCP) test was used to determine the bearing capacity of the in-situ ground. The test was conducted in accordance with *BS 1377: Part 9:1990.* The DCP apparatus consists of a 16 mm diameter steel rod with a 60^0 conical tip. The rod is topped with an anvil. The rod was connected to a second steel rod. This rod was used as a guide to allow an 8 kg hammer which was repeatedly raised and dropped from a height of 575 mm. The connection between the two rods consisted of anvil which allowed for quick connections between the rods and for efficient energy transfer from the falling weight to the penetrating rod.After the test apparatus was assembled, the DCP was placed at the test location and the initial penetration of the rod was recorded to provide a zeroing scale. While holding the rod vertically, the hammer was raised to the top of the rod 575 mm above the anvil and dropped. The penetration of the rod was measured and recorded after each drop. The test was terminated when the desired depth was reached.

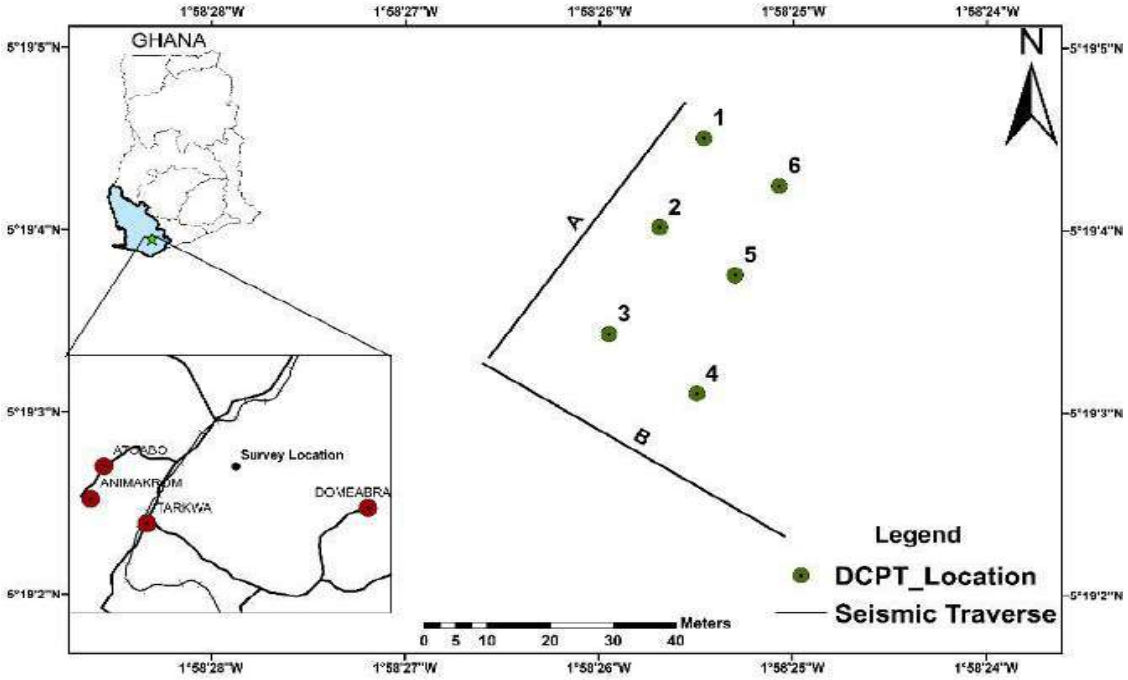

Fig. 3 Locations for Seismic Traverse and DCPT Boreholes

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3.2 Laboratory Works

The laboratory works; sieve analysis and Atterberg Limit test were conducted in accordance with *BS: 1377: Part 2: 1990*. These tests give information about the soil index properties.

Sieve Analysis

The percentages of the various sizes of particles of the soil samples were obtained by dry sieve analysis. The sample was first air dried at a temperature less than 50 ^{0}C, turned over from time to time with a metal scoop to avoid local drying out. The size was reduced by the rifling method. 1000 g of the sample was then weighed. Sieving was performed by arranging sieves in descending order of aperture size with a receiver at the base. The sieve sizes used were in accordance with the BS: 410: 1990. The dried sample was placed on the top sieve, covered with a lid and the whole set of sieves was mechanically shaken for 15 min. The quantity of material retained on each sieve was then weighed.

Atterberg Limit Test

Liquid Limit

The liquid limit apparatus was checked to make sure it was clean. The height through which the Cassagrande cup falls was checked to make sure it was 100 mm. Empty moisture content containers were numbered and weighed. Over 200 g of air dried soil was sieved through a 425 μm sieve to remove the coarser particles. The finer particles were placed onto the glass plate. A quantity of distilled water was added to mix. The fine soil was spread on the glass plate and was thoroughly mixed with the distilled water using the palette knife until it became a thick paste. The sample was kept together in the middle of the glass plate to minimize drying due to exposure to air.

With the Cassagrande cup resting on the base, the palette knife was used to fetch and fill the remixed soil onto the cup. The sample was compressed to exclude any trapped air and levelled to the base to a minimum depth of about 10 mm. A depression was made using the grooving tool along the diameter of the cup that passes through the centre of the hinge. The handle of the machine was turned in an anticlockwise manner at a convenient speed. Counting was made on the number of blows as the machine is turned until the groove closed. The process was repeated for several quantity of the mixed soil and each time it was done, a portion of the material was taken into a labelled moisture content container. The container was weighed with its content, was oven dried for a period of 24 hours and was re-weighed to determine the moisture content.

The material remaining in the cup was returned onto the glass plate and was remixed with the rest of the sample together with a little more water to obtain a uniform mixture. The above procedures were repeated to obtain a lower count of blows. The experiment was conducted for at least 4 different moisture contents so as to have the number of blows that were fairly evenly distributed to be between 50 and 10. The moisture content of the samples obtained from each blows count was calculated. A plot of average moisture content against the average number of blows on the semi-log graph paper was made. The best straight line through these points was drawn and was read off the water content corresponding to 25 blows to the nearest 0.1 %. The result was quoted to the nearest whole number as the Liquid limit.

Plastic Limit

About 50 g of soil sample was prepared for a plastic limit test. The sample was mixed with enough water to form a homogeneous dry paste, just plastic enough to be rolled into a ball of about 15 mm diameter. A ball of soil was rolled between the hand and the glass plate until a thread 3 mm diameter was formed. The thread was manipulated into a ball was rolled repeatedly until the 3 mm diameter thread started to crumble. The thread was placed into a moisture content container, weighed, oven dried and the moisture content was determined. The process was repeated 5 times.

IV. RESULTS AND DISCUSSIONS

4.1 Field Works

Seismic Refraction

As shown in Fig. 3, the seismic refraction survey was conducted along two profiles, thus Profile A and Profile B. Below in Fig. 4 and Fig. 5 are the seismic refraction tomographic models for both profiles where colour bands are used to represent the P-wave velocity passing through each soil or rock layer at subsurface.

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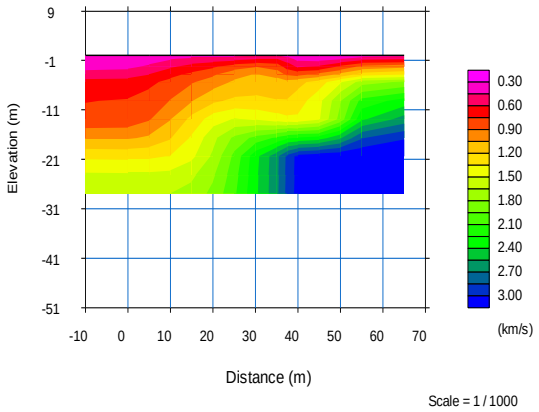

Fig. 4 A 2-D Subsurface Seismic Refraction Tomography Model for Profile A

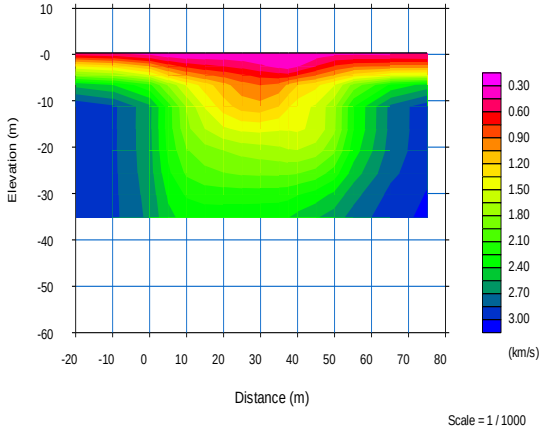

Fig. 5 A 2-D Subsurface Seismic Refraction Tomography Model for Profile B

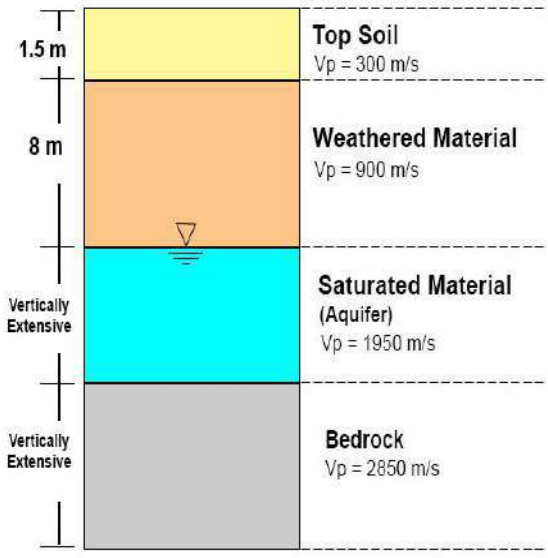

Fig. 6 Stratigraphy of the Study Area and Location of the Water Table

Discussion

Based on the velocities measured from the Seismic Refraction Tomography (SRT), the subsurface layers can be grouped into four.

From the SRT analysis, it can be inferred that the subsurface is made up of four layers. The first layer is a top soil with an average thickness of 1.5 m andan average velocity of 300 m/s. The second layer is a weathered material with thickness ranging from 5 m to 11 m and an average velocity of 900 m/s. The third layer is a saturated material with an average velocity of 1950 m/s. The fourth layer is the bedrock, having an average velocity of 2850 m/s. The analysis shows that the aquifer is unconfined and is located in the third layer, which is a saturated material with seismic velocities ranging from 1500 m/s to 2400 m/s. The depth to the water table is averagely 9.5 m. The SRT results conform to the known geology of the study area.

Bearing Capacity

After the DCPT was conducted, the Ultimate Bearing Capacity as well as the Allowable Bearing Capacity values were plotted against their corresponding depths. Below is Fig. 7 showing the graph obtained. from the DCPT. The tabular representation of the DCPT results are in Appendix A.

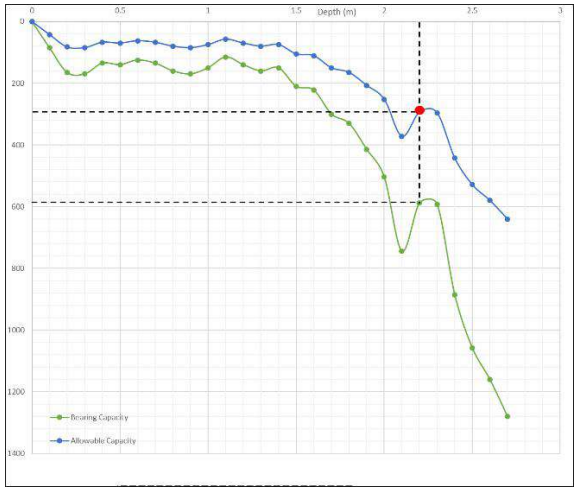

Fig. 7 Graph showing Ultimate and Allowable Bearing Capacities against Depth

Discussion

Based on the graph, a depth of 2.2 m would be convenient for foundation depth. This depth is located in the second layer. At this depth, the ultimate bearing capacity is 588 kN/m^2 and the allowable bearing capacity is 294 kN/m^2. This means that the maximum pressure the foundation can

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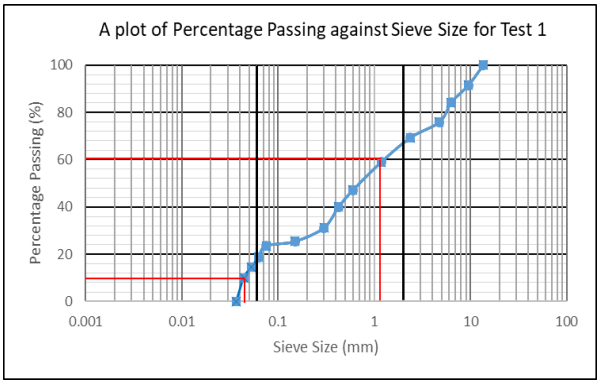
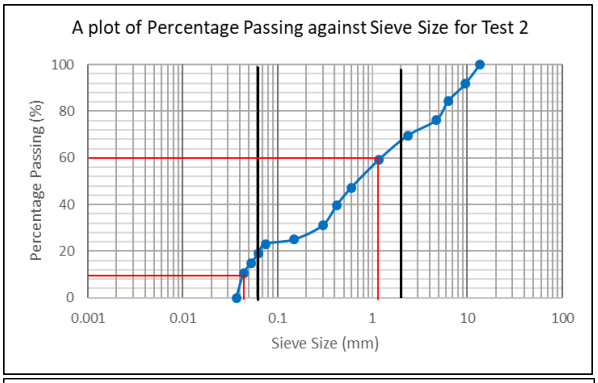
withstand without undergoing excessive settlement is 588 kN/m^2 and the maximum pressure the foundation soil is being subjected to is 294 kN/m^2.

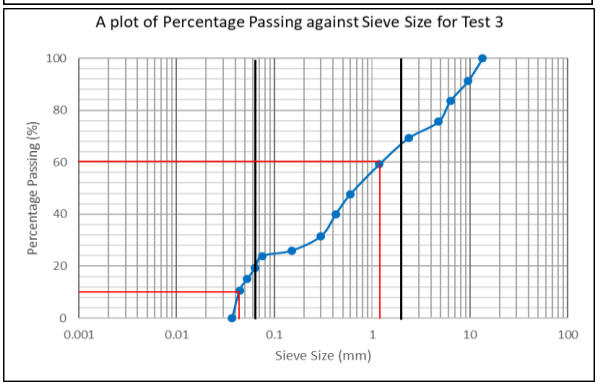
Laboratory Works

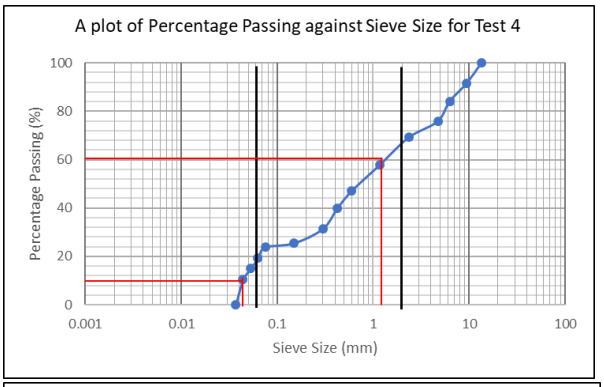
Sieve Analysis

A Particle size distribution graphs were plotted for Tests 1 to 5 in Fig. 8 after the sieve analysis test was conducted. The graphs show the percentages of particular sizes of materials passing through each sieve size.









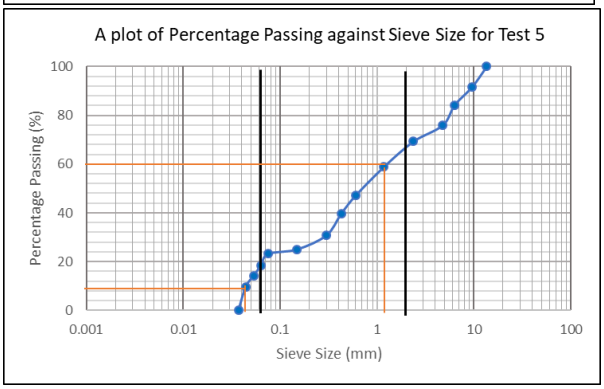


Fig. 8 Particle Size Distribution Graphs for Tests 1 to 5

Table 2 Percentages of soil types at the site

Soil Type	Test 1	Test 2	Test 3	Test 4	Test 5	Average
Silt	19.50	19.00	19.75	20.00	20.50	19.75
Sand	48.50	49.50	50.13	51.00	51.50	50.13
Gravel	32.00	31.50	30.12	29.00	28.00	30.12

Discussion

From Table 2, 19.75% of the soil is made of silt, 50.13% is made of sand and 30.12% is made of gravel.

From Fig. 8, using average values, the Uniformity Coefficient, C_u is computed as

$$C_u = \frac{D_{60}}{D_{10}} \quad \text{.....Eqn.1}$$

$$C_u = \frac{1.200}{0.044}$$

$$C_u = 26.82$$

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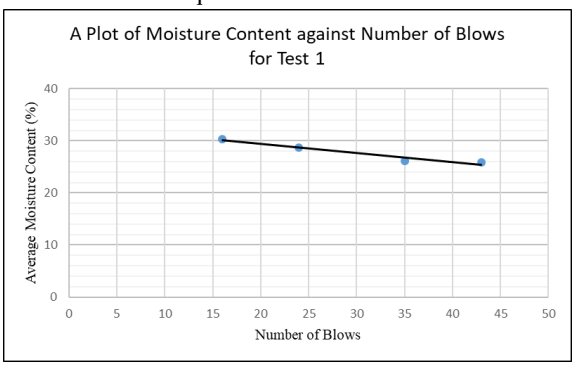
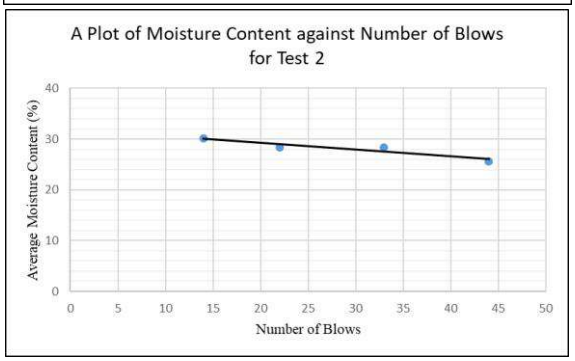
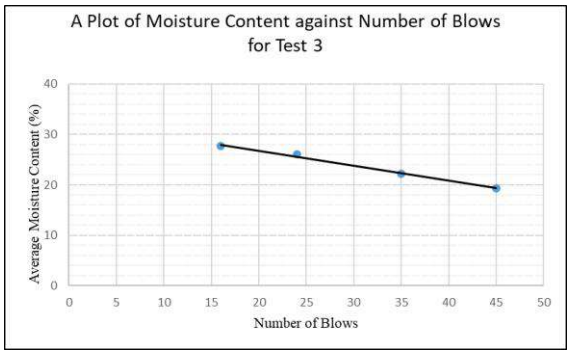
The Uniformity Coefficient is greater than 5, therefore the soil is well graded.

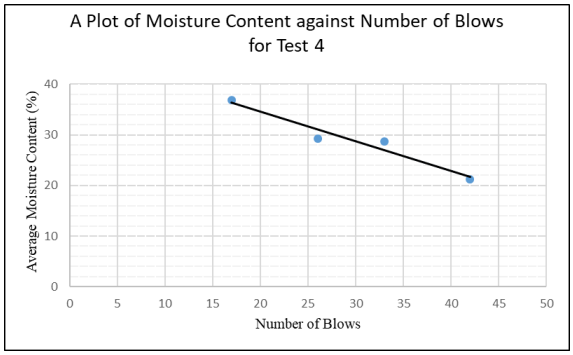
Atterberg Limit Test

After the Liquid Limit test was conducted, a graph of Average Moisture Content was plotted against the Number of blows. The graph in Fig. 9 shows the Flow Curve for Tests 1 to 5 of the Liquid Limit test.









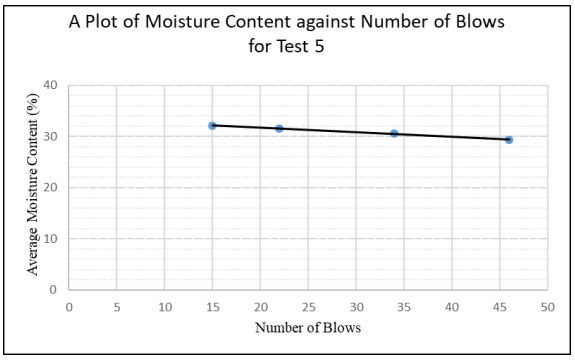


Fig. 9 Flow Curves for Tests 1 to 5

Discussion

Table 3 Liquid Limit, Plastic Limit and Plasticity Index values obtained from Tests

	Test 1	Test 2	Test 3	Test 4	Test 5
Liquid Limit (%)	27.77	28.15	23.83	28.99	30.90
Plastic Limit (%)	19.84	20.59	16.02	21.26	23.18
Plasticity Index (%)	7.93	7.56	7.81	7.73	7.72
Average P.I. (%)	7.75				

From Table 3, the Liquid Limits range from 23.83 % to 30.90 %, Plastic Limits range from 16.02 % to 23.18 % and the Plasticity Index values range from 7.56 % to 7.93 %. This yielded an Average Plasticity Index of 7.75 %. The Plasticity Index and Liquid Limit values were plotted on the Cassagrande Chart shown in Fig. 10 below. Based on the plotting on the chart, it can be said that the soil at the site would be classified as silt with low plasticity.

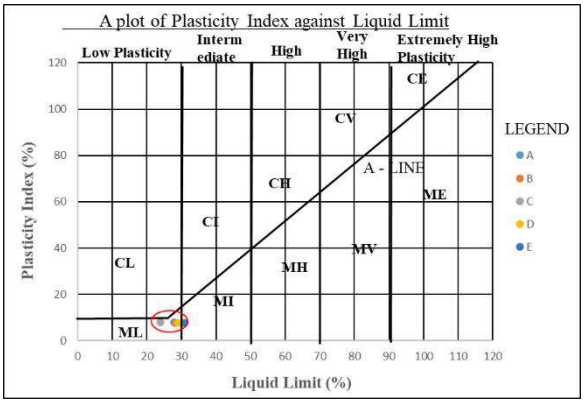


Fig. 10 Plot of Plasticity Index and Liquid Limit on Cassagrande Chart

Swelling Potential

https://dx.doi.org/10.22161/ijaers.69.36 *ISSN: 2349-6495(P) | 2456-1908(O)*

Perk, Hansen and Thorburn (1974) related the plasticity index to the swelling potential of soils in a simple relation shown in Table 4.

The Average Plasticity Index for the Atterberg test was 7.75 %. This value falls within the 0 – 15% Plasticity Index range. Therefore, the soil has a Low Swelling Potential.

Table 4 Relationship between Plasticity Index and Swelling Potential

Plasticity Index (%)	Swelling Potential
0 -15	Low
10 – 35	Medium
20 – 35	High
35 and Above	Very High

V. CONCLUSIONS

- The site has a top soil of 1.5 m thickness and second layer made of 8 m thick weathered material. The third and fourth layers being saturated material and bedrock respectively have vertically extensive depths.
- The depth to the water table is averagely 9.5 m.
- There will be a safe bearing capacity of 294 kN/m² at a depth of 2.2 m.
- The uniformity coefficient of 26.82 shows that the top soil is well graded.
- The plasticity index shows that the soil is Silty with Low plasticity.
- The soil has a low swelling potential.
- All the above results showed that the building would be safe to be constructed on the designated site.
- The detailed subsurface conditions observed shows that the combination of geophysical and geotechnical methods in site investigations yields much information, hence safer.

RECOMMENDATIONS

- A strip footing foundation type should be used.
- The foundation should be made to reach a depth of 2.2 m.
- To enhance the integrity of the foundation of this project, reinforced beams should be used.

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