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# Vol-9, Issue-2, February 2022

(10.22161/ijaers.92)

## Detail with DOI (CrossRef)

### ***Anti-AGE Antioxidants: The Relationship between Free Radicals and Advanced Glycation End-products***

Murilo Porfírio de Aguiar, Tiago Leonetti Barrelin, Maria Paula Prizon Theodoro dos Santos

 DOI: [10.22161/ijaers.92.1](https://doi.org/10.22161/ijaers.92.1)

Page No: 001-006

### ***Assisted Education for Children with Chronic Diseases in Long Stay Hospitality***

Luciano Ribeiro Helvecio, Daniel Rodrigues Silva Silva

 DOI: [10.22161/ijaers.92.2](https://doi.org/10.22161/ijaers.92.2)

Page No: 007-014

### ***A Proposal for an Anthropic Indicator Based on Amazon Community Analysis***

José Guilherme dos Santos Fernandes, Marcos César da Rocha Seruffo, Daniel da Silva Souza, Otávio Rios Portela

 DOI: [10.22161/ijaers.92.3](https://doi.org/10.22161/ijaers.92.3)

Page No: 015-028

### ***Health care organizations: How to achieve excellence in care?***

Luciana Martins Ribeiro, Pamela Nery do Lago, Raque Resende Cabral de Castro e Silva, Karine Alkmim Durães, Juliana Raquel Maciel do Nascimento, Carla de Oliveira Arcebispo, Juliana da Silva Mata, Mariana Regina Pinto Pereira, Maria Emília Lúcio Duarte, Laiana Otto da Costa, Sandra Patrícia Duarte, Aline da Silva Fernandes, Dayana Cristina Ferreira, Fabíola Fontes Padovani, Iara Alves de Sousa, Andreia Aparecida Martins de Carvalho, Luzia Maria dos Santos, Andréia Elias da Cruz Nascimento, Maria Ivanilde de Andrade, João Eduardo Pinho, Carla Renata dos Santos, Ronaldo Antônio de Abreu Junior, João Batista Camargos Junior, Antônia Gomes de Olinda, Leonardo Oliveira Silva, Cristiane Mayumi Miyabara, Jocineia Regina da Silva Santos, Suellen Batista Mariano de Deus, Jeniffer Caroline Rocha de Souza, Joaquina Batista Rodrigues de Souza, Hirlla Karla de Amorim, Andréa Paula Dourado Vasconcelos, Karla Patrícia Figueirôa Silva, Maria Virgínia Pires Miranda, Yasmin Cristine Sousa de Moraes, Gisela Pereira Xavier Albuquerque, Emanuel Rodrigo Melo dos Santos, Luzimare de Matos Avelino Ventura, Francisco Hilângelo Vieira Barros, Tamara Olímpio Prado, Marcelo Dangllys Duarte Fernandes, Edmilson Escalante Barboza, Anderson Fernandes da Silva, Edma Nogueira da Silva, Tatiana Lamounier Silva, Eliseu da Costa Campos, Andreia das Graças Silva de Moraes

 DOI: [10.22161/ijaers.92.4](https://doi.org/10.22161/ijaers.92.4)

Page No: 029-032

### ***The use of Instruments that Facilitate understanding and Correct Analysis of Indicators in Hospital Management: An Integrative Literature Review***

Tatiana da Silva Mendes, Eliane Moura da Silva, Giselly Julieta Barroso da Silva, Walda Cleoma Lopes Valente dos Santos, Edilson Ferreira Calandrini, Lia Crystina Bastos Araújo, Lena Cláudia Maia Alencar, Clayton Alencar Moreira, Mariseth Carvalho de Andrade, Valeria Regina Cavalcante dos Santos

 DOI: [10.22161/ijaers.92.5](https://doi.org/10.22161/ijaers.92.5)

Page No: 033-037

### ***Perspectives of innovation in small companies in Brazil***

Adriano Gomes de Freitas, Alexandre Acácio de Andrade, Julio Francisco Blumetti Facó, Fernando Gasi

 DOI: [10.22161/ijaers.92.6](https://doi.org/10.22161/ijaers.92.6)

Page No: 038-044





### ***Sustainable Finance: A Bibliometric Study of Real Options as a Financial Tool for Making Geothermal Renewable Energy Feasible***

Michel Becker, Dr. Rogerio Lacerda, Dr. Marcus Vinicius Andrade de Lima

 DOI: [10.22161/ijaers.92.7](https://doi.org/10.22161/ijaers.92.7)

Page No: 045-056

<p><b><i>Wind Complexes Environmental Licensing in Bahia backwoods ridges, Brazilian Semiarid</i></b>  <i>Flávio Marques Castanho Barrero, José Alves de Siqueira Filho, Helder Ribeiro Freitas, Juracy Marques</i>   DOI: <a href="https://doi.org/10.22161/ijaers.92.8">10.22161/ijaers.92.8</a></p>	Page No: 057-065
<p><b><i>Socio-environmental effects linked to industrial and port activities in Barcarena, Pará, Brasil: the case of Cuipiranga, ilha Trambioca</i></b>  <i>Diellen Dias de Queiroz, Gracilene Ferreira Pantoja, Yvens Ely Martins Cordeiro</i>   DOI: <a href="https://doi.org/10.22161/ijaers.92.9">10.22161/ijaers.92.9</a></p>	Page No: 066-071
<p><b><i>Reuse of Polychloride of Vinyl (PVC) for the production of synthetic matapi in a rural community of Igarapé-Miri, Pará, Amazônia</i></b>  <i>Gracilene Ferreira Pantoja, Graciete Pantoja Antunes</i>   DOI: <a href="https://doi.org/10.22161/ijaers.92.10">10.22161/ijaers.92.10</a></p>	Page No: 072-076
<p><b><i>The role of the health professional in chemotherapy treatment in elderly patients</i></b>  <i>Luzia Francisca Teles, Gleison Faria, Mariana Kely Diniz Gomes de Lima, Jackson Firigolo, Taís Loutarte Oliveira, Iuri Santana de Jesus, Karolayne Soares Cavalcanti, Francisco Leandro Soares de Souza, Gesnaquele Souza da Cruz, Ana Karolina Monge Silva Romano Mendonça, Camila Carla de Souza Pereira, Paulo Henrique Campos da Silva, Leticia Estefani de Oliveira, Daiary da Silva Bolett, Rogério Krause, Thais Antunes Betin, Francielly Maira Bordon, Iane Carbonera Solcia, Tatianny Ketyllynn Abreu Silva, Narasandra Gonçalves Nascimento, Keitty Karina Silva Santos, Giselen Maleski Cargnin, Marco Rogério da Silva</i>   DOI: <a href="https://doi.org/10.22161/ijaers.92.11">10.22161/ijaers.92.11</a></p>	Page No: 077-083
<p><b><i>Palliative Care in Amyotrophic Lateral Sclerosis: A View of Comprehensive Care</i></b>  <i>Letícia Almeida de Assunção, Mariana Souza de Lima, Neiva José da Luz Dias Júnior, Glenda Keyla China Quemel, Alzinei Simor, Igo Felipe Azevedo da Silva, Jorgeany Soares Parente, Luiz Euclides Coelho de Souza Filho</i>   DOI: <a href="https://doi.org/10.22161/ijaers.92.12">10.22161/ijaers.92.12</a></p>	Page No: 084-089
<p><b><i>The Teacher's Knowledge/Doing About Active methodologies for meaningful Learning in Higher Education: An Integrative Review</i></b>  <i>Oswaldo Luis Carvalho, Danielle Cruz Rocha, Eluane Costa Carvalho, Eluana Costa Carvalho</i>   DOI: <a href="https://doi.org/10.22161/ijaers.92.13">10.22161/ijaers.92.13</a></p>	Page No: 090-098
<p><b><i>Hydrologic data base Management Analysis of Small Islands in the River Region of Maluku</i></b>  <i>Silwanus M Talakua, Obednego D Nara</i>   DOI: <a href="https://doi.org/10.22161/ijaers.92.14">10.22161/ijaers.92.14</a></p>	Page No: 099-105
<p><b><i>Reduction of Axial Forces in Column in Multistoried Building using Optimum Size Approach at Earthquake Zone III</i></b>  <i>Nitesh Kushwaha, Arvind Vishwakarma</i>   DOI: <a href="https://doi.org/10.22161/ijaers.92.15">10.22161/ijaers.92.15</a></p>	Page No: 106-115
<p><b><i>Microcultures and the nationalist speech</i></b>  <i>Marcelo Manoel de Sousa, Saraí Patrícia Schmidt</i>   DOI: <a href="https://doi.org/10.22161/ijaers.92.16">10.22161/ijaers.92.16</a></p>	Page No: 116-123
<p><b><i>Environmental Related Disputes on Trade Issues in GATT and WTO from 1982-2002</i></b>  <i>DAJIO Blessing LEIF</i>   DOI: <a href="https://doi.org/10.22161/ijaers.92.17">10.22161/ijaers.92.17</a></p>	Page No: 124-135

<p><b><i>Agricultural Land Utilization for Beef Cattle Business Development in Kediri City</i></b>  Rizky Putra Bakti Purnama, Siti Azizah, Siti Chuzaemi   DOI: <a href="https://doi.org/10.22161/ijaers.92.18">10.22161/ijaers.92.18</a></p>	<p>Page No: 136-159</p>
<p><b><i>Analysis and elaboration of lemon balms teas (melissa officinali l.) in São Gabriel da Cachoeira-AM</i></b>  Cleoni Virginio da Silveira, Anderson Pedro Bernardina Batista, Elias Fernandes de Medeiros Júnior, Renato Valadares de Sousa Moreira, Luís Gustavo Marcolan, Rosibel Rodrigues e Silva, Marcelo Côrtes Silva, Anderson Aquino Leiria   DOI: <a href="https://doi.org/10.22161/ijaers.92.19">10.22161/ijaers.92.19</a></p>	<p>Page No: 160-164</p>
<p><b><i>Spatio-temporal dynamics of land use in the municipality of Tori-Bossito in southern Benin</i></b>  Gaétan Georges Guedegbe, Louis Dèdègbè Ahomadikpohou, Toussaint Vigninou, Et Follygan Hetcheli   DOI: <a href="https://doi.org/10.22161/ijaers.92.20">10.22161/ijaers.92.20</a></p>	<p>Page No: 165-175</p>
<p><b><i>Perceptions of Teachers of Higher Education of Law in Nanuque-MG before the Student Performance Exam Enade</i></b>  Larissa Dolores Figueiredo Mendes, Daniel Rodrigues Silva   DOI: <a href="https://doi.org/10.22161/ijaers.92.21">10.22161/ijaers.92.21</a></p>	<p>Page No: 176-181</p>
<p><b><i>Determinants of Productivity in Brazil: An empirical analysis of the period 1996-2021</i></b>  Hugo Ferreira Braga Tadeu, Jersone Tasso Moreira Silva   DOI: <a href="https://doi.org/10.22161/ijaers.92.22">10.22161/ijaers.92.22</a></p>	<p>Page No: 182-192</p>
<p><b><i>Bakassi Women in Cross-Border Trade with Nigeria (1963 to 2016): Motivations and Constraints</i></b>  Ngoufo Sogang Théodore, Ebai Bakow Abigail   DOI: <a href="https://doi.org/10.22161/ijaers.92.23">10.22161/ijaers.92.23</a></p>	<p>Page No: 193-203</p>
<p><b><i>Food Selectivity and Nutritional Conduct in Children with ASD: An Integrative Review</i></b>  Nayanne Ballman Canuto Teixeira, Lorena Vidal Rodrigues da Silva, Paula Raimunda Araújo Teixeira, Luisa Margareth Carneiro da Silva   DOI: <a href="https://doi.org/10.22161/ijaers.92.24">10.22161/ijaers.92.24</a></p>	<p>Page No: 204-224</p>
<p><b><i>The cause of Kabul's environmental problems is its impact on economic and human health</i></b>  Hikmatullah Ahmadi, Qais Tawheed, Noorullah Rafiqee, Khwaja Bahman Qaderi, Mohammad Shabir Sharifi, Habibullah Sharifi   DOI: <a href="https://doi.org/10.22161/ijaers.92.25">10.22161/ijaers.92.25</a></p>	<p>Page No: 225-234</p>
<p><b><i>Educational technology to guide self-care for elderly patients at hospital discharge to the home: An integrative review</i></b>  José Daniel Rodrigues dos Santos, Creusa Barbosa dos Santos Trindade, Valeria Regina Cavalcante dos Santos, Xaene Maria Fernandes Duarte Mendonça, Ellaine Valéria Araújo da Silva Lima, Brenda Laryssa Lima Gonçalves, Bianca Camila Neves Siqueira, Jacirene Vasconcelos de Albuquerque, Vitória Fernanda Valadares Coelho   DOI: <a href="https://doi.org/10.22161/ijaers.92.26">10.22161/ijaers.92.26</a></p>	<p>Page No: 235-243</p>
<p><b><i>Self-reported oral health of a quilombola population in the semi-arid region of Piauí</i></b>  Nadjane Bezerra de Sousa, Maria Vieira de Lima Saintrain, Mirna Albuquerque Frota, Patricia Ribeiro Vicente, Janaína Alvarenga Aragão, Luciano Silva Figueiredo, Cesário Rui Callou Filho, José Manuel Peixoto Caldas, Patricia Maria Santos Batista, Evandro Alberto de Sousa   DOI: <a href="https://doi.org/10.22161/ijaers.92.27">10.22161/ijaers.92.27</a></p>	<p>Page No: 244-251</p>

<p><b><i>A study on the circulation and retention levels of a Digital Social Currency using an Agent-Based Model</i></b>  Wagner Vieira Ramos, Eduardo Henrique Diniz   DOI: <a href="https://doi.org/10.22161/ijaers.92.28">10.22161/ijaers.92.28</a></p>	Page No: 252-258
<p><b><i>A Review on Nickel Recovery of Batteries by chemical Process</i></b>  Jaqueline Tomasini Orth, Andreia Cristina Furtado, José Ricardo Cezar Salgado   DOI: <a href="https://doi.org/10.22161/ijaers.92.29">10.22161/ijaers.92.29</a></p>	Page No: 259-264
<p><b><i>Quilombola Women in Brazil</i></b>  Flávia Abud Luz, Mônica Abud Perez de Cerqueira Luz   DOI: <a href="https://doi.org/10.22161/ijaers.92.30">10.22161/ijaers.92.30</a></p>	Page No: 265-269
<p><b><i>Monitoring of biodigesters through a computerized system integrated to IoT platform</i></b>  Francisco Paulo Henrique de Andrade, John Hebert da Silva Félix, Francisco Henrique Lemos Andrade, Deyk Anne Calixto Paz, Juan Carlos Alvarado Alcócer, Olienade Ribeiro de Oliveira Pinto   DOI: <a href="https://doi.org/10.22161/ijaers.92.31">10.22161/ijaers.92.31</a></p>	Page No: 270-278
<p><b><i>Vegetative growth of radish in different organic substrates</i></b>  Rérison Magno Borges Pimenta, Emicleiton Duarte de Abreu, Leidiane de Jesus Oliveira, Fabio Del Monte Coccozza, Cristiane Domingos da Paz, Rubens Silva Carvalho   DOI: <a href="https://doi.org/10.22161/ijaers.92.32">10.22161/ijaers.92.32</a></p>	Page No: 279-282
<p><b><i>The role of health professionals in the care of patients with prostate cancer: Literature review</i></b>  Gleison Faria, Mariana Kely Diniz Gomes de Lima, Jackson Firigolo, Gesnaquele Souza da Cruz, Washington Cruz Silva, Rogério Krause, Taís Loutarte Oliveira, Iuri Santana de Jesus, Karolayne Soares Cavalcanti, Paulo Henrique Campos da Silva, Ana Karolina Monge Silva Romano Mendonça, Narasandra Gonçalves Nascimento, Keitty Karina Silva Santos, Cleverson de Oliveira Santos, Leticia de Paula Repke, Queila Schulze de Almeida, Queila Alves de Oliveira Souza, Ramone de Souza de Jesus, Anatiely da Paixão Silva, Francielly Maira Bordon, Giselen Maleski Cargnin, Pedro Washington Moreira Antunes, Marco Rogério da Silva   DOI: <a href="https://doi.org/10.22161/ijaers.92.33">10.22161/ijaers.92.33</a></p>	Page No: 283-289
<p><b><i>Evaluation of the Environmental Quality of a Cemetery using the Method of the Peir Matrix - Case Study</i></b>  Eduardo Antonio Maia Lins, Olga Marine Rios, Diogo Henrique Fernandes Paz, Danielle de Castro Pessoa Melo, Adriana da Silva Baltar Maia Lins   DOI: <a href="https://doi.org/10.22161/ijaers.92.34">10.22161/ijaers.92.34</a></p>	Page No: 290-297
<p><b><i>Protocol for dilution of standardized anti-infective injectable drugs in the Public Hospital Network of the state of Tocantins</i></b>  Karolaine Andrade Rocha, Rayanne Ribeiro de Sá, Yara Silveira, Marlllos Peres de Melo, José Antônio Pereira, Thalita Melo França Costa, Lucas Cardoso Santos, Moziane Alves Guimarães, Natallia Moreira Lopes Leão, Matheus Viana Maciel, Hédipo José Ribeiro e Silva, Renata Ferreira Diogo, Carla Rodrigues Cunha, Vanderson Ramos Mafra   DOI: <a href="https://doi.org/10.22161/ijaers.92.35">10.22161/ijaers.92.35</a></p>	Page No: 298-311
<p><b><i>Environmental Engineer Profile: Active Learning in Engineering Education</i></b>  Priscilla Chantal Duarte Silva, Ricardo Luiz Perez Teixeira   DOI: <a href="https://doi.org/10.22161/ijaers.92.36">10.22161/ijaers.92.36</a></p>	Page No: 312-325



*Analysis of the Current Management of Health Service Waste: A Case Study of a University Hospital in Manaus/AM*


Maria do Carmo Costa Silva, Paola Souto Campos, Marcelo Franklin de Almeida Ramos

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Page No: 326-337

*The role of university extension in promoting local economic development: A preliminary discussion in light of the specificities of a small municipality*

Tânia Márcia de Freitas, Maria do Carmo Romeiro

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Page No: 338-344

# Anti-AGE Antioxidants: The Relationship between Free Radicals and Advanced Glycation End-products

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**Keywords**— *AGEs, Antioxidants, Free radicals.*

**Abstract**— *Advanced glycation end-products (AGEs) are molecules both directly and indirectly responsible for many geriatric diseases. Some individuals may accumulate more AGEs than others due to several factors, individuals who accumulate more AGEs tend to manifest diseases such as Alzheimer's, arteriosclerosis and type 2 diabetes earlier in life. Free radicals have direct and indirect influence on the amount of serum and tissue AGEs, which leads to the question of whether the effects of AGEs can be attenuated by using exogenous and endogenous antioxidants. In this paper, we conducted a literature review on the compositions, origins, and associated pathologies of AGEs, in addition to the combat and prevention by antioxidants. Thirty-five scientific papers published between 1994 and 2021 in English and Portuguese were identified via SciELO, PubMed, Elsevier and Scopus. Through this review, we conclude that the direct and indirect relationship between AGEs and free radicals is a fact and no longer a speculation. In addition, there are studies that have been able to show the efficiency of some antioxidants in controlling specific AGEs, now commonly referred to as anti-AGEs antioxidants.*

## I. INTRODUCTION

Advanced glycation end-products (AGEs) are molecules that result from chemical reactions taking place both in the body and in the external environment. Most reactions that generate AGEs in the body happen naturally and are considered physiologically normal reactions. However, today, there is much scientific evidence to indicate that AGEs are directly and indirectly responsible for many geriatric diseases, such as Alzheimer's, osteoarthritis and arteriosclerosis [1] [2]. AGEs are linked to geriatric diseases because they tend to accumulate throughout life and tend to prevail, despite having natural mechanisms for their elimination [3].

There are countless types of AGEs, and many are discovered over the course of days. Much of what is understood about the formation of AGEs can be attributed to the scientific findings cataloged by the French scientist Louis Camille Maillard in the beginning of the 20th century. Maillard managed to understand and communicate information about these molecules that until that time were considered to come solely from the external environment. Because of this, his findings are often related to bromatology.

In general, the formation of AGEs consists of blending a carbonyl or aldehyde group of one molecule with an amino group of another molecule. Part of the structure of a

carbohydrate fuses with part of the structure of an amino acid. The results of this fusion – known as glycation – are the Schiff bases which, due to natural chemical interactions, become a new structure called an Amadori product. Amadori products can interact with many other molecules, and of these interactions can result in AGEs [1] [3] [2].

Of all the reactions that an Amadori product can undergo to become an AGE, the one related to free radicals is one of the most cited by the scientific community. Through oxidation, free radicals destabilize the electrons of one or more atoms of Amadori molecules. An example of this is carboxymethylisine, which is an AGE resulting from the interaction between transition metal ions and Amadori products [4].

Many antioxidants have already been shown to be potentially capable of controlling the generation of AGEs, both in vitro and in vivo [5][6]. If AGEs are related to geriatric diseases and some antioxidants can reduce the generation of serum and tissue AGEs, then it is necessary to study these antioxidants to prevent disease.

Free radicals are atoms with an odd number of electrons in their last electron shell [7]. Due to this energetic irregularity, these atoms tend to transmit, split, or steal electrons from other atoms, resulting in changes in the chemical structure of molecules exposed to them [8]. They can be isolated, become part of a molecular region, or compose the entire structure of a molecule [9]. Many types of free radicals are naturally formed in the body, such as the case of hydroxyl radicals (OH•), formed during cell respiration [7].

Antioxidants are substances that can control molecules affected by free radicals by preventing their formation and capturing the free radicals already formed. Regardless of the form, studies show that some antioxidants can decrease free radical exposure to Amadori products, consequently decreasing the formation of AGEs. Such antioxidants are called “anti-AGEs antioxidant”, and can be either naturally generated inside the body or ingested [2].

## II. METHODOLOGY

A scientific review of the literature was conducted. We identified 40 scientific papers written in English and Portuguese between the years 1994 and 2021. Of the 40 papers, only 5 did not meet our search criteria, which was based on compatibility, legitimacy, and clarity of reference sources. The papers were found on the following scientific platforms: SciELO, PubMed, Elsevier and Scopus. The keywords used in the search were: “AGEs”, “antioxidants”, and “free radicals”. In the searches for

content in Portuguese, the following keywords were used: “AGEs”, “antioxidantes” and “radicais livres”.

The 35 papers were meticulously reviewed for the following content: advanced glycation end products, free radicals, and antioxidants. This paper presents an introduction to the content and scope of these papers.

## III. RESULT

### 3.1. AGE RECEPTOR-1

AGE Receptor-1, more commonly referred to as “AGER1”, is part of the membranous structure of some human cells. It is often part of an even larger structure called AGE-R complex. AGER1s are considered antioxidants because they serve as receptors for AGE molecules, enabling their endocytosis and subsequent degradation by lysosomes. The destruction of AGEs generates a substance commonly referred to as SIRT1, which promotes less inflammation and oxidative stress, and decreases free radicals, as shown in figure 1 [10]. AGER1s are common in the membrane and endoplasmic reticulum of mesangial cells, cells that occupy the space between the capillaries of a glomerulus. This receptor is present in smaller amounts in patients with kidney diseases, especially kidney diseases as a result of diabetes [10] [11].

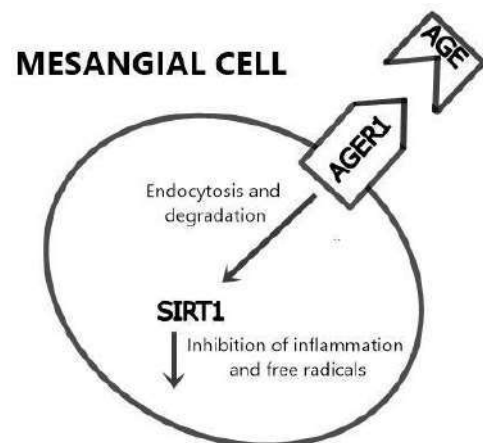


Fig. 1: Formation of SIRT1 by a mesangial cell after recognizing an AGE through its AGER1 receptor.

Some studies have shown that in the face of excessive exposure to AGEs, mesangial cells tend to gradually lose AGER1, which contradicts the belief that their defense would be equivalent to the damage suffered [10].

### 3.2. SCAVENGER RECEPTOR CLASS B

Scavenger receptors are structures found mainly on the membrane of some leukocytes. They are commonly divided into types A and B, but there have been attempts to

expand the classification to eight classes, A, B, C, D, E, F, G and H. Type B is most related to the control of AGEs. This control is due to the ability of the receptor to interact with oxidized molecules, i.e., the ability to attract molecules that contain atoms with alterations in their number of electrons [12]. It is because of this fact that scavenger type B receptors can be considered anti-AGE antioxidants. AGEs in contact with scavenger receptors are endocytosed and degraded, forming AGEs of low molecular weight as metabolic waste, which are easily excreted by the urinary system. A few studies refer to low molecular weight AGEs resulting from degradation by scavenger cells as “second generation AGEs”, and these AGEs can also be highly reactive [13]. However, because its lifespan in the body is extremely short-lived due to excretion through the urine, it does not cause much concern except in patients with kidney problems.

A few studies have sought or are still seeking an alternative for individuals with kidney problems to control circulating AGEs, especially second-generation AGEs, with the efficiency close to that of a healthy person. The lysozyme protein is one of the most mentioned possibilities, its presence in the blood circulation contributes in several ways to the control of AGEs, mainly in the scope of excretion via the kidney [1] [13] [14]. However, there are not enough studies to recommend it in practice as a treatment, not even preventive, especially because many possible mechanisms have not yet been explored, and the performance of these mechanisms are debated.

### 3.3. ASCORBIC ACID

The antioxidant power of ascorbic acid, better known as vitamin C, has been recognized for many decades. This is why it became the main molecule studied for possible anti-AGE antioxidant actions. Its preventive capability against diseases such as diabetes and arteriosclerosis was already known, even before the understanding of AGEs [15] [16] [17].

Some papers have reported impressive results, such as a 50% decrease in serum AGEs in individuals after just 4 weeks with daily administration of vitamin C [18]. According to the pharmaceutical company Merck Sharp and Dohme (MSD), the recommended daily dose of vitamin C is 90mg for men over 19 years old. However, some studies argue that the dosage must be specified for each individual, as each individual's body tends to have particularities that can shape the action of the vitamin, affecting its antioxidant action [19].

The action of vitamin C in combating AGEs consists mainly of two parts; the inhibition of glycation by regulating the cellular transport of glucose [18] [19] [20],

and the inhibition of free radicals. The way in which vitamin C inhibits free radicals was discussed once again, this feat was justified by its stimulative relationship with the superoxide dismutase (SOD) enzyme, a circumstance today contrary to the results of important studies [21] [22]. This fact does not discredit the anti-AGEs antioxidant capacity of vitamin C, it only shows that its action involves mechanisms that are not yet fully mastered.

### 3.4. SELENIUM

Selenium is a chemical element that makes up the structure of molecules in many foods but is usually found only in small amounts, with the exception of Brazil nuts (*Bertholletia excelsa*) – 100g provides 45 times more selenium than 100g of cooked white rice [23]. It was through the use of Brazil nuts that many studies were carried out on selenium, mainly in relation to anti-oxidation. The results provided evidence for inhibition of AGEs through the reduction of molecules that expose carbonyl groups and result in genetic damage [24].

Molecules (mainly aldehydes) that have carbonyl groups in their chemical structure, are likely to bind to the amino groups of some amino acids. This results in formation of the aforementioned Schiff bases, precursors of Amadori products, and consequently AGEs [1]. Much of Selenium's actions are due to the fact that it composes amino acids called “selenocysteine”, amino acids that participate in cellular redox (exchange of electrons between molecules involved in cellular respiration) [24] [25]. In controlled situations, cellular redox correctly manages all electron exchange. Other atypical situations will result in free radicals [25].

### 3.5. ALPHA-TOCOPHEROL

Tocopherols, better known as vitamin E, are common components of vegetable oils. Their chemical structure can vary between four main forms:  $\alpha$ ,  $\beta$ ,  $\gamma$  and  $\delta$ -tocopherol.  $\alpha$ -tocopherols are most commonly linked to the control of AGEs [26] [27].

Studies consider vitamin E to be the most potent antioxidant against peroxy free radicals, or those coming from lipoperoxidation, which are the alterations of the lipid components in face of free radicals, mainly reactive oxygens. Lipoperoxidation causes cellular problems mainly related to the cell membrane including identification, entry, and exit of substances [28]. They are given the title of anti-AGE antioxidants by some authors mainly because they decrease the glycated hemoglobin index when administered to volunteers [29] [30], which serves as evidence for a possibility to block the formation of other Amadori products.

### 3.6. EUK-134 AND MNTBAP

The SOD enzyme, already mentioned in the topic on ascorbic acid, is one of the most potent reactive oxygen inhibitor molecules [3] [7] [19]. It is a difficult molecule to stimulate, as recent studies have demystified the ability of vitamin C to boost serum and tissue SOD levels [21] [22]. Given this situation, many pharmaceutical companies propose developing replicas of SOD enzymes. Of these, two are close to success: the enzyme EUK-134 and MnTBAP [3].

Both synthetic enzymes have been suggested for treatment of kidney dysfunction, type 2 diabetes, and even neurological problems [31] [32] [33] [34]. No negative reviews were found regarding the enzymes, except that the doses used in studies were considerably high, and there were significant variations in administration methodologies. Even so, there are no oral versions in United States or Brazil for use in treatments, only a version for topical use with aesthetic purposes. This use is currently not recognized by the Food and Drug Administration (FDA), nor by National Health Surveillance Agency (ANVISA); however, it is easily found for sale in both countries. Studies involving these synthetic enzymes are also numerous and comprehensive [31] [32] [33] [34] [35]. The reason for not yet having authorization for sale or use in medical practice is not explicit.

## IV. DISCUSSION

Although many scientific papers do not use the term “AGEs”, it is clear that they indirectly address such molecules. Many nutrition papers tend to link diets rich in antioxidants with a reduction in diseases such as Alzheimer's and arteriosclerosis [20] [21] [22] [26]. This fact, along with the results of research involving anti-AGE antioxidants, makes clear the long-term power of antioxidant-rich diets.

As for the safe doses of the endogenous antioxidants mentioned here, there is no consensus. Some studies used larger amounts, others smaller, than those recommended daily by official bodies, making us question whether the recommended dose can be effective in combating AGEs [6] [18] [20] [24] [30]. In regards to synthetic antioxidants, their absence in the medical field is intriguing, as many of them have more safe studies than some drugs already released for consumption, which leads us to believe that there may be technical or industrial challenges [3] [31] [32] [33] [34].

## V. CONCLUSION

We conclude through this review that there is already a scientific consensus that AGEs are responsible for several geriatric diseases. Patients less exposed to AGEs have better success rates in preventing and treating diseases in almost all papers analyzed involving geriatric diseases.

It is also currently a consensus that free radicals trigger higher levels of serum and tissue AGEs, including natural free radicals, such as those coming from cellular respiration. And some antioxidants can indirectly reduce the exposure of individuals to AGEs, as they control important free radicals. Because of this, these antioxidants were named anti-AGE antioxidants by the scientific community.

Finally, we conclude that there are many studies proving the effectiveness of many synthetic antioxidant molecules. However, these molecules seem to have stagnated in their path towards use in medical practice. The reason for this is unclear but could be related to industrial and bureaucratic difficulties.

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# Assisted Education for Children with Chronic Diseases in Long Stay Hospitality

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**Keywords—** Assisted education, Hospital bed, Hospital pedagogy.

**Abstract—** Some a priori criteria are fundamental in order to indicate an alternative for the educational assistance offered to hospitalized children with chronic pathology so that they can rely on systematic and recognized actions. In this sense, this qualitative research was carried out with health professionals and education professionals who perform this type of service. We can observe that the educator is given the role of looking for ways to identify how best to achieve the educational results of this person, parents and health professionals are emphasizing the importance of information about the child's chronic disease, observing the influence of the programs of education in a way that produces more benefits in terms of understanding and caring for children. Our focus is on understanding how the State should take the necessary measures so that the right to education of children with chronic diseases is respected and fulfilled. Since education is everyone's right, and far from any discrimination, hospitalized children must be able to take this right as a fundamental guarantee for their intellectual development. At the end of the study, we qualitatively evaluate the possibilities that such practices have in offering and providing the students with better and more modern conditions of study and, at the same time, knowing the teaching methods that allow an alternative form and effective education programs even though they are the patient undergoing medical care. From these premises.

## I. INTRODUCTION

Hospital beds are introduced as a teaching modality for Special Education, duly regulated by specific legislation (Resolution number 41, of October 13, 1995) which provides pedagogical-educational care for hospitalized children and adolescents. In view of this, it starts from the recognition that these juvenile patients, once they are away from the school routine as well as restricted from the common coexistence with colleagues, are under the threat of school failure and possible disorders to their development.

The objective of this study is to identify the needs related to these students in order to facilitate the

implementation of proposals to improve education for children who experience long and repeated hospitalizations due to a chronic illness that presents intrinsic physical, mental and psychological characteristics during their stay.

Therefore, our study includes professionals who work with this group of students with chronic diseases in need of regular education, which is an extremely heterogeneous group in terms of different characteristics and needs. A common shared characteristic is their illness, which influences and determines their educational experiences.



## II. DEVELOPMENT

### ASSISTED EDUCATION

The MEC (Ministry of Education and Culture) established, during the year 1994, through the National Secretariat of Special Education, the responsibilities regarding the implementation of the due right to education of children and adolescents who are hospitalized, through the formulation of the National Policy of Special Education, which legally established the service of hospital classes.

Inclusion seeks to help vulnerable student groups. The current hospital stay limit for a patient with a chronic disease is approximately 12 months, although some doctors consider a duration of at least 3 months to be considered a chronic disease (Brasil, 2019). The literature indicates that in child hospitalization, the primary motivation for stimulating the child to develop.

It is in the person who involves them, daily, in their care, whether for food, for hygiene, for playing, for a technical nursing procedure. The personal involvement of the caregiver transmits to the sick child the essential experience, the human contact (Bortolote, 2008).

In this context, educators seek and seek to adapt the planning of regular content in classes peculiar to students, so that they can assist them in their school reintegration as soon as hospital discharge is granted.

According to the definition provided by the WHO (World Health Organization), we judge chronic diseases as “long-term diseases” and, in general, “under slow progression”, with the development of the disease producing disturbing situations that affect aspects of the disease. medical, psychological, social, family and educational

The school education of children hospitalized with chronic diseases indicates that this should be an ongoing objective when providing educational assistance to these students and that this intervention requires a significant change in the institutional curriculum.

However, teachers must have information about their students' illnesses and effective ways to respond and address their students' physical and academic needs.

Schools should offer more options and more influential avenues for the participation of parents and health professionals who make up the clinical staff in daily activities in hospitals, as collaboration between parents, teachers and health professionals facilitate the development and greater trust between them. different

groups, this collaboration being effective in improving and covering the attention dedicated to students with chronic diseases.

As for teachers, they need the support of other professionals involved in the daily activities of hospitals (nurses, nursing technicians, physiotherapists, etc.). This support should address the needs related to the patient with chronic diseases that arise in the hospital environment, providing clear definitions of health and its limitations.

Teachers need administrative support from hospitals to facilitate the fulfillment of their care for students with chronic diseases. This support must be provided through an attitude of commitment, trust and information, with relationships involving communication and collaboration which must be established between schools and hospitals that can offer information and support for needs that may arise during follow-up.

When programming these practices, it presupposes the establishment of an inclusive model of schools as a whole. In this model, all students with chronic diseases, regardless of their individual characteristics, conditions and abilities, can participate and learn. Furthermore, differences are not a basis for discrimination, but rather generate acceptance, respect and improvement.

## III. HOSPITAL BED IN BRAZIL

At the beginning of the 20th century, according to Barros (2011 p.20), when the diseases of misery (such as leprosy, tuberculosis and syphilis) were barely differentiated from mental insanity, it was a vanguard attitude to distinguish, within the asylum, the asylum for children. The historical rescue of the Bourneville School Pavilion is relevant for this study, which add memories to the chronology of schooling in hospitals in Brazil. The Bourneville School Pavilion for Abnormal Children, from the National Hospice for the Insane in Rio de Janeiro, founded in 1902 and extinguished in 1942. In Brazil at the beginning of the 20th century, it was a common practice for children to be hospitalized in asylums. Partly for economic reasons,

The origin of the possible hospital class in Brazil being linked at the same time with the origin of special education in our country, asylums for the insane help to understand the belonging to which schooling in hospitals was framed when it finally became regulated as a teaching modality.

Thus, the same 1930s of the 20th century anticipated the closing of the Bourneville Pavilion, announcing the emergence of the first, officially recognized, special

classes in the wards of the Santa Casa de Misericórdia de São Paulo.

The educational service created in 1600 in the Irmandade da Santa Casa de Misericórdia, in São Paulo, according to Caiado (2003 p.73), was destined to the school attendance of the physically handicapped. It was found in the archives of this hospital annual reports of the school movement of students with physical disabilities (non-sensory) dating from 1931. Professor Lourenço Filho was Secretary of Education of the City of São Paulo in 1931. In 1932 another special class was created, as Escola Mista do Pavilhão Fernandinho. In 1948, according to Mazzotta (2003 p.39), a third class was installed with the appointment of Professor Francisca Barbosa Félix de Souza who remained until her retirement in of March 1980. In 1982, ten special state classes were operating at the Santa Casa de Misericórdia Central Hospital in São Paulo. technically, these classes all function as hospital classes or, still, configuring the “hospital teaching” modality, that is, each teacher has an individualized care schedule for students who are patients in the hospital. Despite having started in the 1930s, it was only after 1953 that more accurate records were found.

The right of the Brazilian hospital class was recognized by the Declaration of the Rights of Hospitalized Children and Adolescents (Resolution number 41, of October 13, 1995, of the National Council for the Rights of Children and Adolescents) due to the concern of the Brazilian Society of Pediatrics in mapping the set of care needs for children or adolescents who need health care in hospital settings.

The Ministry of Education and Sports formulates the National Policy for Special Education (MEC, 1994), proposing that education in hospitals be carried out through the organization of hospital classes, ensuring that education is offered not only to children with developmental disorders, but also to children and adolescents at risk for development, as is the case of hospitalization, since hospitalization determines restrictions on coexistence relationships, on interactive school social opportunities (relationships with colleagues and learning relationships mediated by a teacher ) and the intellectual export of social life environments (Fonseca, 1999).

According to the National Constitution (BRASIL, 1988), the Statute of Children and Adolescents (BRASIL, 1990), the Organic Health Law (BRASIL, 1990) and the Law of Guidelines and Bases for Brazilian Education (BRASIL, 1996), health care must be comprehensive (promotion, prevention, recovery, etc.) and school

education must be in accordance with the special needs of students (OLIVEIRA, 2004).

Seeking to adapt to the legislation in force, the MEC, through the Secretariat of Special Education, proceeded to review its documentation regarding strategies and guidelines for pedagogical work for people with special needs (Fonseca, 2003). From this review, the area of teaching hospital care and home care now have a publication that regulates these types of care called: Hospital Class and Pedagogical Home Care: strategies and guidelines (BRASIL, 2002). This document aims to structure and promote the provision of pedagogical care in hospital and home environments in order to ensure access to basic education and attention to special educational needs.

#### IV. PEDAGOGY OF THE HOSPITAL CLASS

It is known that chronic diseases translate into great difficulties for patients, as well as for their families and also for the health system, as they tend to cause certain limitations in capacities, responsibilities or even social roles, which are essential. medications, specific diets, medical procedures, assistance and supports, as well as the personal intervention carried out by caregivers and professionals from the diverse fields of health. Even more, and according to the specifications of the Ministry of Health, obstacles can arise in terms of the adaptation of students and teachers, either due to deficiency in cognitive capacity, or learning losses caused by the inability to attend school (Saúde, 2013).

The preparation of teachers and their relationship with health personnel are essential to the education these students receive. The quality of student teaching is in the hands of the teacher. However, because of the close relationships that students with chronic illnesses develop with their nurses, the characteristics of each child and their associated illness are often better understood by these professionals than by their teachers. Often, families maintain a more direct relationship with health professionals than with their child's educator. For this reason, it is important to establish the role of each professional in the context of the education of children with chronic diseases.

Therefore, Darella MS (2007), deduces that even offering care for diseases, sometimes incurable, in a deep relationship of connection with life, the health team has the possibility of restoring, in addition to the organism, the forgotten subjectivity of the child, as they undertake comprehensive care behaviors. In the context of children, chronic diseases have long durations and seriously

compromise daily life and therefore require intensive and lasting treatment.

The temporary threshold for caring for and treating a chronic illness is approximately 12 months, although some doctors consider illnesses lasting for at least 3 months to be part of the list of chronic illnesses. When a prolonged illness appears in a school-aged child, the affected student can fall far behind even before 3 months if proper actions are not taken. Educating a child who experiences long and repeated hospitalizations and who presents physical, mental and psychological characteristics during the appearance, course and feeding of the disease can produce disturbing situations that affect medical, psychological, social, family and educational aspects.

According to Leal (2009), another way found by families as a means of facing the diagnosis of their child's chronic disease is familiarization and acceptance of the diagnosis. Therefore, such factors are associated with the uniqueness of the people involved, as well as the real state of the disease and the context in which the disease occurs. In this way and so that treatment and education occur in a synchronized and adequate way, it is necessary to emphasize that health professionals and educators clarify doubts, demystify myths and offer support to each other, since the emergence of a disease almost always appears as a shock to the values, habits and beliefs of families.

The school is the fundamental place for the student to meet systematized knowledge. However, in order to enable pedagogical and educational follow-up and guarantee the continuity of the school procedure for children and young people in regular education, guaranteeing the conservation of the connection with the school of origin, through a flexible and adapted curriculum of the teaching action, a differentiated reception program to children and young people admitted to Hospitals, who need special educational support, so that they do not lose their connection with the school, offering systematic and differentiated care, within the scope of Basic Education, individual or collective in Hospital Class or in bed, according to the needs of the student who is unable to attend school provisionally. In addition to an environment suitable for the Hospital Class,

According to Ceccim and Carvalho (1997) the perception that, even when sick, the child can play, learn,

create and, above all, continue to interact socially, often helps in the recovery, so the child will have a more active attitude towards the victim through the situation. In this way, we can highlight two forms of pedagogical follow-up: occasional hospitalizations and recurrent or extensive hospitalizations.

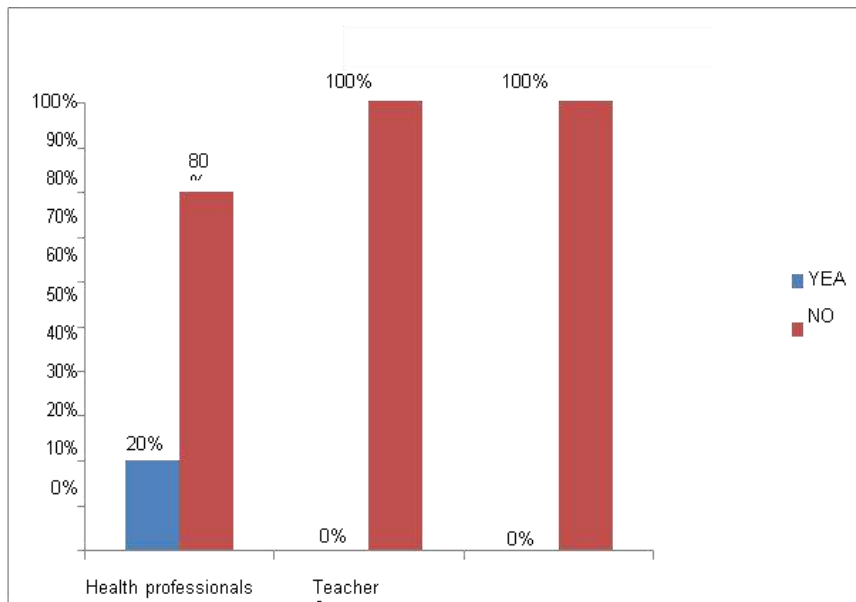
The creation of teaching and learning classes in hospitals is the result of public policies and studies resulting from the consideration of the educational needs of children who require hospitalization, whether short or long term. So that, throughout this chapter, it is about this pedagogical space that has been constituted by its excellence and urgency, in Brazilian society.

A hospital educational care program comprises a set of educational support actions that are carried out in the hospital for the care of the student who, due to illness, cannot attend school for a while due to his stay in the hospital. Winnicott (1999) warns for the importance of the bond between the child and the person who cares for him or interacts with him. The author draws attention to the fact that there is always a relationship of dependence between individuals. For the author, individual isolation would be harmful to health, to the point of feeling independent and vulnerable. In this line of reasoning, if this person is alive, without a doubt, there is dependence on the family or on the members of the health team who provide care. According to this line of thought,

## V. DATA ANALYSIS

To obtain the results, the interviewees answered a questionnaire containing 10 (ten) questions. Fifteen (15) people were interviewed, being 05 health professionals residing in the municipality of "President Kennedy" ES, and 05 (five) parents of students who attend the Pestalozzi Institution of Presidente Kennedy -ES, 05 teachers who provide service at the Institution President Kennedy-ES Pestalozzi.

The information obtained in the questionnaires allowed guiding a greater analysis of the subject addressed. The responses made it possible to analyze and prepare the comparative graphs, as expressed below:



Graph 1: Do you know the rights of students who are in a hospital bed?

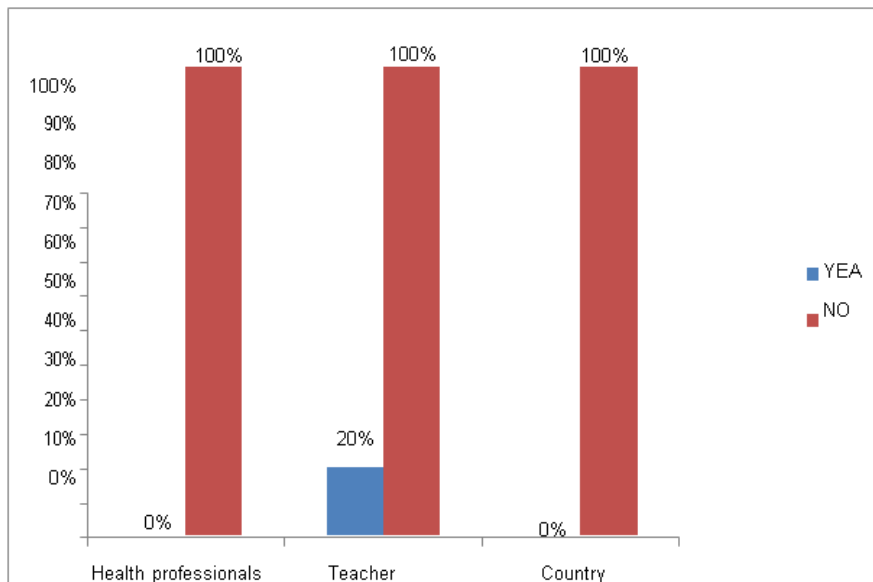
Source: Material produced by the author to illustrate the research..

The first question questions the level of knowledge of the interviewees on the subject addressed, it is observed that the lack of information regarding the legislation is 100% in relation to teachers and parents, who are directly in contact with the student in the patient situation. (Graphic 1).

Health professionals, when approached, report that they do not know the legislation and most are unaware of the subject and also do not see the need to worry about the legislation, they believe that parents should seek to know to carry out the collection. When we ask the teachers, everyone knows that there are laws that guide the

hospital class, however, they did not bother to study the subject, they prefer to leave it to the school manager so that they can solve it with the family. Regarding the parents surveyed, they do not have any knowledge, they did not know that there was this right, they were informed that they would need to present certificates to justify the absences, and the content was delivered in the form of a handout, where there was a deadline for return, that is, there is no pedagogical monitoring of these students,

When addressing the knowledge of patients in the municipality who need a hospital class, the answer was as follows:

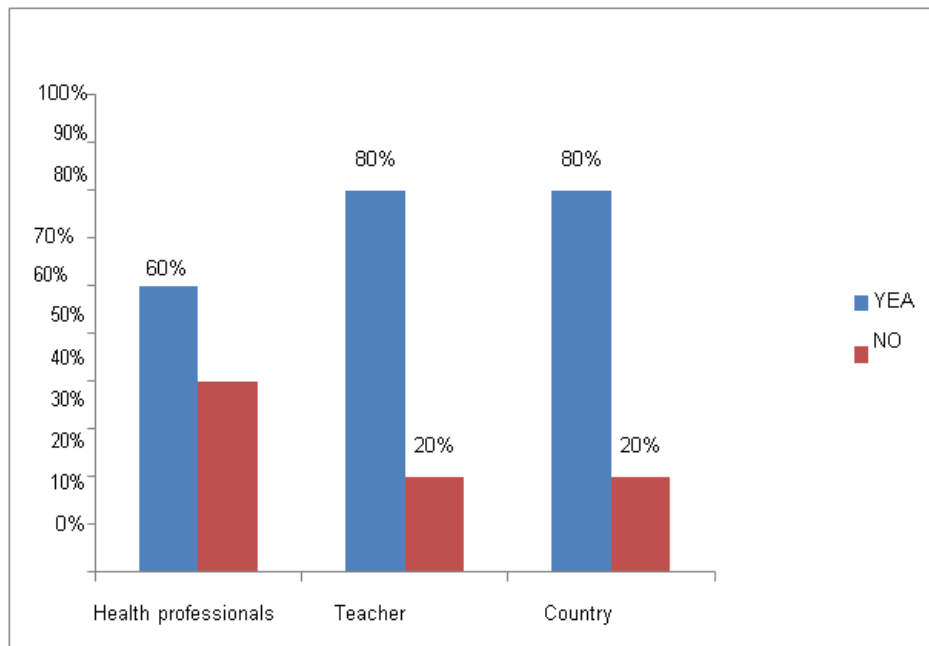


Graph 2: In your city, have you ever witnessed any assistance to students in hospital beds?

Source: Material produced by the author to illustrate the research.

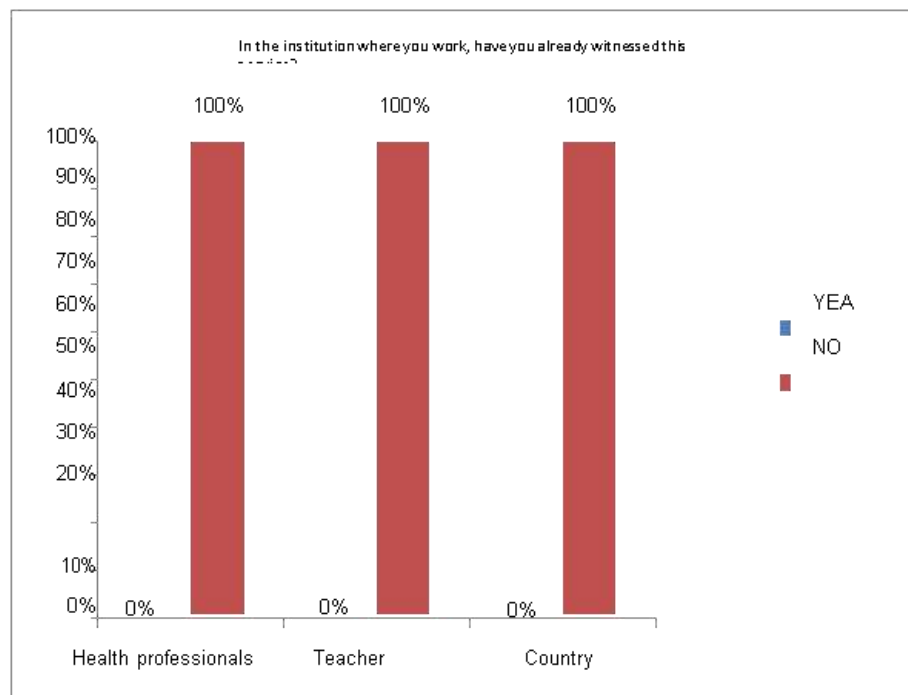
It is observed that the health professionals who were the agents of the research and the parents in question agreed that they had never been aware of students in the municipality receiving care in a hospital class. Among the

teachers, 20% said they knew of a case in the municipality of hospitalization with follow-up of the hospital class, but the majority of the interviewees claimed not to know of any case in the municipality. (Graph 2)



Graph 3: Do you know someone in your municipality who would have this right to care?

Source: Material produced by the author to illustrate the research.



Graph 4: In the institution where you work, have you already witnessed this service?

Source: Material produced by the author to illustrate the research.

As can be seen in Graph 3, the interviewees claim to know someone who needs educational assistance in a hospital bed, as was to be expected among health

professionals the identification is lower 60% know someone, among teachers and parents the information reaches 80% of respondents. (Graph 3)

It is noticed that unfortunately people become aware of the problem, but do not make it possible to solve it. Hospital Educational Assistance should be collective actions, involving the family, the school, the multidisciplinary team, the municipal and state Department of Education and the philanthropic unit. Thus, it moves the construction of pedagogical-educational strategies that contribute to improving the student's clinical condition, ensuring that their rights are preserved in this moment of fragility caused by the disease. The main thing is that this change of view makes us see our children and adolescents clearly and, therefore, makes it possible to increasingly focus on them, on their interests, needs and possibilities.

We also address the fact that the interviewees have ever witnessed this service at the institution they work for:

In Graph 4, we can see that all the interviewees have never witnessed this service in the municipality, which makes us reinforce that despite such importance, Educational Hospital Service has been a topic of little prominence, especially in relation to the urgency of ensuring the implementation of classes. hospitals in all institutions, guaranteeing universal education coverage for all children and adolescents, according to their conditions and possibilities.

Therefore, given that the equal right to education in the hospital environment, in addition to being a social issue, is a public health issue, it becomes contradictory not to find these Hospital Classes in the context of most hospitals, that is, there is a contradiction in relation to what is guaranteed or provided for in the legislation. Thus, the concerns that led to the study of this topic begin with the realization that a child's development cannot stop due to hospitalization.

## VI. FINAL CONSIDERATIONS

From this research, it was possible to verify that the great challenge of the hospital class is information, discovering the true meaning of the hospital class is to go beyond the previous knowledge that one hears about. It is important to know the current legislation and how to use it in practice to favor those who need this type of care. Much is said but little is done. We were surprised that when we searched for information relevant to the subject, we came across a lack of preparation and knowledge to discuss the subject.

Hospital classes are essential nowadays, since we live in a globalized world, where access to information is a channel of knowledge for everyone, although we still have people who settle down and do not seek the rights of their

children, thus, in this perspective that, we seek to understand the hospital environment considering its educational interfaces in the face of the challenges in the teachers' performance, as well as the possibilities and confrontations in favor of the health of the child in treatment, in an approximation with teaching-learning.

Children and adolescents, due to their current health condition, are unable to share the intellectual social experiences of their family, their school and their social group. to families, since the health status of their children makes parents worried, causing them to forget the children's studies, prioritizing hospital treatment, for not knowing or not understanding that the association of health with the educational and recreational process accelerates the process of recovery, promoting early hospital discharge and the continuity of the minor development.

Proof of this was the study carried out by Fonseca (2003), which shows that, in addition to providing the guarantee of the right to continue their studies, so that they are not harmed in their schooling, the Hospital Class also contributes to their improvement within your clinical picture.

We noticed, through the statements of the interviewed teachers, that, even though the need for pedagogical support in the hospital is recognized, resistance is still high, as greater value is attributed to clinical practices.

Hospital pedagogy shows its relevance in this process as it makes it possible to think about the school process in the hospital context, in the perspective that does not leave aside attention to organic aspects, to health care, but carries investment in education. This movement goes beyond supplying the absence of school content, it is the process that invests in the continuity of life.

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# A Proposal for an Anthropic Indicator Based on Amazon Community Analysis

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**Keywords**— *Socio-environmental  
Indicators, Anthropization, Amazon.*

**Abstract**— *This work aims to produce indicators according to the perception of residents of communities and ecosystems of the Amazon biome, through the collection and analysis of the results of a form in which they express their impressions about events and practices of anthropization. The results found allowed the application of the analytical method of decision making (Analytic Hierarchy Process – AHP), to indicate the degree of anthropization of the people surveyed on a hierarchical scale, according to the syntagma of the three ordering axes of the themes of the form. The contribution allows the generation of correlation models, which help the understanding of the relationship between humans and the environment and the level of anthropic perception of those involved.*

## I. INTRODUCTION

The economic, social and environmental indicators are important instruments to measure aspects of the society as they favor guidelines for quality of life and local development, helping participative administrations in the promotion of inclusive public policies. However, the vast majority of indicators are based on information produced by public or private institutions for the generation of their indexes – aggregate numeric value generated at a given moment, resulting from the application of indicators –, many times in limited temporal and spatial scales, according to the set of values and ideas that each institution has for the moment.

In the case of government institutions, the indicators can be manipulated according to the interests of the occupants of positions, as we see in the current Brazilian moment since 2020, with the socio-environmental

problems in the Amazon, caused by the pandemic and a policy of benefiting the business community, with the consequent depreciation of traditional and local populations, implying as an effect the dismantling of protectionist environmental policies: the result is the increase in deforestation and fires, even though the government insists on saying that it maintains a protectionist policy.

This is why institutional indexes and indicators may be unable to represent more reliably the environmental, cultural, and socioeconomic diversity of the Amazon region. This is also why we propose the production of information from the inhabitants of the communities and ecosystems of the Amazon biome, through a form in which they manifest themselves according to their impressions of an event or a practice, based on references of vegetative (survival) and volitive (enterprise in space) anthropization.



Let's not forget that with about 610 million hectares, the vast Amazon region is home to different peoples and traditional populations, besides holding the greatest diversity of fauna and flora species on the planet. But the sheer size of the region's rivers and forests, allied to the mythological contours of the indigenous people, takes the focus off an even bigger problem, generated by exogenous socioenvironmental and cultural matrixes, translated into the low indexes attested by several indicators, such as the Human Development Index (HDI), the Social Progress Index (IPS, in Portuguese) or the Social Vulnerability Index (IVS, in Portuguese); the Basic Education Development Index (IDEB, in Portuguese) ranking; in addition to the deforestation rate Project for Monitoring Deforestation in the Legal Amazon by Satellite, of the National Institute for Space Research (PRODES/INPE, in Portuguese).

With such negative indices for human development, how can we understand the miraculous imaginary of wealth and pomp in the Amazon? This is what we propose with this study, from a perspective that allies exogenous indicators, based on income, well-being, education, and opportunities, with autochthonous indicators, sustained by the practices and values of the Amazonian peoples and communities (ethos and labor), so that we can understand that the Amazon is more than a naturalistic painting, because here there are people who think and work on a daily basis. "Humanizing" the region, understanding conflicts and agreements between peoples and local communities from their subjective impressions and measurements: we believe to be the greatest contribution of our proposal of indicators, even because an initiative of this size is not duly right in previous proposals for referencing the Amazon, propositions more concerned with socioeconomic and environmental data, little or nothing considering the heritage and values of local populations anthropized for millennia.

Fernandes & Fernandes (2018, p. 89) consider anthropization as the interaction between distinct groups that use the same territory and are directly affected by mutual transformations that affect environmental knowledge, ideologies, and identities. This relational perspective leads us to the construction of indicators that consider (inter)cultural translation as the priority method to achieve this relativism. Thus, the scientific relevance of the anthropic indicators lies in the dialogue of knowledges, from which derives its social relevance, since it is constituted from collaborative research of researchers and practitioners.

What we propose with the anthropic indicators, in addition to establishing references of vegetative (survival) and volitional (enterprise in space) anthropization, is the

production of information from the residents of the communities and ecosystems of the Amazon biome, through a form in which they manifest themselves according to their impressions of an event or a practice. In short, a proposal that aims to create indicators and indexes based on the experience and values of autochthonous communities, to provide answers to the following recurring problems in research on the Amazonian reality: a) the picturesque vision of foreigners about rivers and forests that has led to a conception of inexhaustibility of biodiversity in the region; and b) the eccentricity imposed on local populations, in consideration with the colonialist vision about Amazonians, which is at odds with the low indexes in social, economic and educational indicators of local populations.

### 1.1 Global and National Indicators and Indexes and the Amazonian Reality

The construction of development indicators and indexes in the societies of the Northern Hemisphere (United States, Canada, Western Europe, Japan) has its origin in the post-World War II period, when the Cold War and economic production as a vector for the growth of human societies were strengthened. Growth is understood as the capacity of these countries to accumulate capital and promote industrialized consumption, which would mean social welfare:

This way of structuring the system presupposes, on the one hand, a regime of accumulation that is guided by Keynesian economic policy principles and, on the other hand, by institutional mechanisms of socioeconomic regulation that articulate classes and social groups within the Welfare State (Santagada, 2007, p. 114) (free translation).

In this model of contractual and redistributive society of capital accumulation, it was necessary to build economic indicators so that there would be equity in identifying the actors who would need more social assistance and who could participate in anti-poverty programs; however, these data, being produced by the State and favorable to numbers that justified the model of cumulative and consumerist society, masked the antagonism of social classes. An example of this markedly economic view of indicators is the Gross Domestic Product (GDP), which is the sum of all goods and services produced in a country or state over a given period (usually a year), measured in accordance with the prices that reach the consumer. However, the GDP does not actually measure the wealth of a country or of the people in that country, but rather the flow of money resulting from

buying and selling transactions, which certainly does not qualify the social condition of each consumer.

It was only after the 1960s that the economic view of the national indexes gained social meaning with the appearance of the expression social indicators through the work of Raymond Bauer Social Indicators, which, like so many other studies in this line, sought to analyze the social conflicts arising from the concentration of wealth, which widened the gap between the top of the social pyramid and the base composed of a large majority of impoverished people. But the growing gap between social classes would be amplified with the advent of neoliberalism in the 1980s, which decreed the destatization of production, the loosening of economic regulation, and the loss of labor guarantees and social welfare. On the other hand, the pre- and post-neoliberal scenario, with growing human and social inequality touched by private property and enrichment, favored organizations such as the United Nations and its associated bodies to elaborate supranational reports starting in the 1970s, to “serve as a tool for government planning, as well as to overcome strictly economic analyses. Social conditions are now part of the list of concerns not only of specialists, but also of governments” (idem, p. 121), which led the concept of welfare and quality of life to compose with economic factors what should be considered as a country’s development.

In the wake of this socioeconomic consideration, and with the accentuation of neoliberal policies mainly in emerging countries, in the 1990s there was a resumption of the importance of social indicators, being elaborated and monitored by international organizations, such as the UN, and by non-governmental entities. The issue is that most of the data that make up the indicators are fed by government agencies or linked to nation-states, which projects a myopic view of the real social conditions. On the other hand, the construction of indicators and their indexes, such as the Human Development Index (HDI), produced by the United Nations Development Program (UNDP), implies the use of paradigms still referred to the consumerist model of a largely Eurocentric society. Let’s look at this global index.

Comprised of three variables – life expectancy at birth, access to knowledge, and standard of living – this index ends up creating a false idea that human development is tied to the accumulation of capital and unsustainable production. For example, the country that ranks first in the HDI/UNDP/UN, according to the 2020 report (UNDP, 2020), is Norway, with an overall index of 0.957, on a scale that goes up to 1.000. Brazil occupies the median position of 84th and the last place goes to the African Niger (189th place). It is quite symptomatic that

this ranking reverberates the hegemonic process, with the colonizer-imperialist in first place, the colonized nation in second, and the imperialized nation in third. Norway reaches excellent levels in quality of human development when it presents 35 hospital beds and 29.2 doctors per 10 thousand inhabitants, while Brazil has only 21 beds and 21.6 doctors for the same population; even worse is Niger with 0.4 doctors and 4 hospital beds. In education, the HDI takes into account the Programme for International Student Assessment (PISA), of the Organization for Economic Cooperation and Development (OECD), which is intergovernmental and Eurocentric. According to this evaluation, Norway shows 499 in Reading, 501 in Mathematics, and 490 in Science; Brazil 413 in Reading, 384 in Mathematics, and 404 in Science; and Niger does not even present data on these educational indicators. It is worth remembering that the top twenty countries in education have scores above 475.

PISA, as a system for evaluating education, relates the years of schooling as a measure of the acquis acquired by students during this time, thus being a model derived from economics, when using factors of production (input) to produce a product (output) (Villani; Oliveira, 2018). According to these authors, the Basic Education Development Index (IDEB, in Portuguese), implemented by the Anísio Teixeira National Institute for Educational Studies and Research of the Brazilian Ministry of Education (INEP/MEC, in Portuguese), reproduces the principles of PISA, since the former considers the bases of the latter as to the comparative monitoring between countries and/or regions based on the assessment of students’ skills to solve real problems, reflecting, consequently, the students’ level of knowledge and experience; but in this process, a standardized and universalistic assessment instrument is favored, which largely favors the more economically developed countries.

However, Norway’s high human development rates plummet when it comes to environmental sustainability. In 2018, each Norwegian emitted 8.7 tons of carbon dioxide, compared to 2.2 tons for Brazilians and 0.1 ton for each inhabitant of Niger. In Norway in 2017, per capita household material consumption was 21.8 tons, compared to 17.4 tons in Brazil and 3.4 tons in Niger. But even with high rates of potential environmental pollution, in the assessed year 2015 Norway did not have a single percentage of its territory degraded, unlike Brazil which had 27% and Niger with 7%. But how to explain this? It seems that the high human development index of the Nordic country and its European counterparts is achieved at the expense of the environment, which is often not their own, but that of peripheral countries that produce the raw materials for the comfort of the Nordic countries. In an

interview to the newspaper El País, Pedro Conceição, director of the UNDP office in Brazil, stated that “there is currently a gap between achieving high human development and low pressure on the planet”, because a country’s very high prosperity has implied great environmental impacts.

With this contradictory reality at a global level, what to consider as human development? It seems that one of the alternatives is to include a socio-environmental bias in the social indicators, particularly after the Stockholm Conference, in 1972, and the emblematic United Nations Conference Eco-92, held in the city of Rio de Janeiro, 20 years after the first one: both were milestones in global discussions about the environment and sustainability. With this, not only the environmental variants in social indicators are now considered, but the indicators are also given a more local and less global accent. Hence the emergence of national versions of the HDI, such as the one developed by the UNDP office in Brazil, in conjunction with the Institute for Applied Economic Research (IPEA, in Portuguese) and the João Pinheiro Foundation (FJP, in Portuguese). In the same sense, there is the Social Vulnerability Index (IVS, in Portuguese), also produced by the IPEA with the purpose of highlighting situations indicative of social exclusion and vulnerability in Brazil. We can still highlight other indicators created around the world, such as the Ecological Footprint, which quantifies the surface of productive land or water that an individual, city, country or population uses to produce what they consume and to absorb the waste generated in this process; the Gini Coefficient, which calculates inequality in income production; the PER Index, which indicates the state of nature in the face of human impacts, with pressure on biodiversity, the state of nature and societies' responses to such impacts; Material Sobriety, which refers to the production and consumption of energy used in the generation of material goods, implying a radical reconfiguration in the relationship between individuals and their consumption habits, particularly regarding acquisition, possession, and moderate and not excessive use. These are some examples of indicators and indexes that have emerged with the fourth wave of revitalization of social indicators allied to the sense of biodiversity and sustainability of human societies (Santagada, 2007).

Regarding the Amazon, we can highlight two indicators, the IPS and the Project for Monitoring Deforestation in the Legal Amazon by Satellites (PRODES, in Portuguese), even though there are others related to the loss of vegetation, such as the Deforestation Detection System in Real Time (DETER, in Portuguese), which is the deforestation alert system, and the System for Estimating Emissions and Removals of Greenhouse Gases

(SEEG), an initiative that reports on greenhouse gas emissions (GHG). PRODES measures the annual rate of deforestation in the region, producing an inventory of primary forest loss by means of clear-cut mapping, using images from Landsat class satellites; this work is carried out by the National Institute for Space Research (INPE, in Portuguese). Another indicator is the IPS, which emerged in 2014 through the Social Progress Imperative, a global non-profit organization based in Washington (DC/USA), which provides data to governments and citizens in general about social and environmental health, with a view to social progress. This organization is formed, in large part, by researchers from the Massachusetts Institute of Technology (MIT), Harvard University (USA), and Oxford University (UK).

In Brazil, this index gained an edition for the Amazon (IPS, 2018) and that had as national partner the Institute of Man and Environment of the Amazon (Imazon, in Portuguese). To construct the IPS, social and environmental variables are considered, excluding those of an economic nature; the following fundamental questions are posed: 1) Are the most essential needs of the population being met?; 2) Are structures in place to ensure that individuals and communities improve or maintain their well-being? 3) Are there opportunities for all individuals to reach their full potential? These questions are answered through three dimensions: 1) Basic Human Needs; 2) Foundations for Well-Being; and 3) Opportunities. It is these dimensions that comprise the indicators.

In a brief reading of the IPS, we can state that between the years 2014 and 2018 the general index was unfavorable to our region, since there was a drop of 0.79 point while in the country the drop was 0.52. The most relevant is to observe that Basic Human Needs, such as water, sanitation and housing are neglected, since while Brazil in general has a score of 73.52 the Amazon presents 59.2. This condition is reflected even in the Municipal HDI, when the municipality with the worst national index is Melgaço (5565th place), on Marajó Island (State of Pará), precisely because it has the worst income distribution in Brazil (index 0.454, when the national average is 0.739, in the year 2010), with a discrepancy of 0.285; In education, according to the Municipal HDI, this distance is even greater, with the Marajoara municipality reaching an index of 0.207 against the national index of 0.637, an absurd difference of 0.430.

Therefore, both the IPS and HDI models are unanimous in saying that in income distribution and school education the Melgacenses are infinitely inferior to the Nordic Europeans. But what would be the model of transmission of knowledge and of symbolic and venal

exchanges in the distant Melgaço, a Brazilian homonym of a city of the Portuguese colonizer? In order to find these autochthonous models of human needs, of wellbeing, and of localized human development, we need to listen to the impressions and valuations of the natives, because they are the ones who, in their ancestral process of anthropization, should be heard so that there are public policies in which they are the major stakeholders, the success of which is in the proportion that we include their daily practices and values in dealing with the ecosystem in which they live. This is the starting point for the construction of our anthropic indicators.

## II. MATERIAL AND METHODS

The objective of this article is to produce indicators of anthropization from human, heritage and environmental factors related to various conceptions of sustainability and “well-being” of Amazonian peoples and communities. To achieve this objective, it is necessary to understand anthropization as the human intervention in natural elements, being these biotic or abiotic elements not built by the human species in its genesis. This intervention can cause destructive actions, when the “anthropized spaces, frequently, are the spaces in which human action has destroyed the original biota, particularly in function of a predatory model of survival, which ignores any possibility of sustainability” (FERNANDES; RAMOS, 2020, p. 30).

Another, less usual, conception of the term anthropization refers to “constructive human action when, in a given territory, a certain human group takes possession, builds the conditions for survival and manages them, in order to have control and production of the means to do so” (idem, *ibidem*). Therefore, human action, as a rule, promotes transformations in natural space and thereby generates environmental impacts, which can be negative anthropization or positive anthropization, according to the view of sociocultural groups considered in the research: the first may lead to reduction, simplification or loss of biodiversity, or even replacement or destruction of ecosystems; the second implies protection and resilience of environments, resulting from actions of preservation or conservation, touched by the state, or by individuals and communities.

In any case, there will always be greater or lesser impacts resulting from human action on the environment and in accordance with the practices and values of the anthropized groups. Immediately, this environment corresponds to biomes and ecosystems. In our research the biome means the Amazon, marked by a certain homogeneity in the biocenosis and in the biotope, resulting from the vegetation cover of tropical rainforest, warm and humid climate, high rainfall with average

precipitation above 2,300 mm/year, relief of large alluvial plains, sandy soil pedology with humus layer, immense watershed with flow in the Amazon estuary of 200 million liters of fresh water per second. The Amazon biome, even despite a certain homogeneity in its configuration, presents ecosystems due to different conformations in the biocenosis and biotope. Thus, it is that the environmental impacts of anthropization are felt, according to their origin, differently by each ecosystem. Therefore, our equation for the construction of the object was:

BIOME  $\longrightarrow$  ECOSYSTEM  $\longrightarrow$  ANTHROPIZATION  $\longrightarrow$   
 COMMUNITIES = POSITIVE ANTHROPIZATION OR  
 NEGATIVE ANTHROPIZATION

We conclude, preliminarily, that the environmental impact will be recognized as a degenerative decompensation in the human-environment relationship dependent on the affected ecosystem and the anthropized group, that practices or suffers the event, which leads us to consider the anthropic profile as the first step to be considered in understanding indicators; in other words, the impact is derived from traits of behavior and productive skills, the first ones being the “qualities of the character in action in the environment, touching on the space of existence – biocenosis/biotope and human economic practices in the environment – and the forms of sociability in dealing with the environment” (FERNANDES; FERNANDES, 2018, p. 99) and the second concerning the techniques of economic production in the used territory.

Therefore, identifying the anthropic subject as the object of research was the initial step of constructing the method of indicators. This subject must favor our instrument according to: validity (adequacy to measure the phenomenon), reliability (trustworthiness to the event), and representativeness (coverage achieved of the event). In the case of indicators that refer to human actions on the environment, whether constructive or destructive actions in relation to the preservation or conservation of the original biotic and abiotic environments, the validity of the indicators lies in the extent to which one seeks to delineate the human reasons for the transformation of environments, spaces, and landscapes and to configure the scenario of the resulting environmental consequences, establishing correlations between causes and effects. By understanding the sociocultural reasons that trigger environmental impacts, it is understood that we will be better able to indicate paths to sustainability and good living: these are the axes of the questionnaire produced, with questions aimed at the inhabitant of the ecosystems chosen in the research, which seems to us to be the appropriate instrument, since it seeks the reasons in the impressions and speeches of the ecosystem user himself.

The **reliability** of the indicators selected here refers to the data collected, since their production occurs from individuals representative of traditional peoples and communities, through the application of a qualitative questionnaire. And why should data collection occur primarily among subjects from traditional peoples and communities? Because they are groups culturally differentiated by their: self-recognition of their identity; parental and kinship-based social organization, hence more communitarian; use of knowledge, practices and innovations based on oral tradition; and mainly by their strict bond with territory for the production and reproduction of their existence, this (territory) being configured as a broad and complex ecosystem of knowledge based on experience. Particularly, the reliability comes when there is the prioritization of the research locus of traditional communities living in sustainable use units, indigenous lands and quilombola territories, since the focus of this project is the traditional peoples and communities of the Brazilian Amazon. Thus, we will be in line with article 7, of Law 9985/2000, which established the National System of Nature Conservation Units.

Finally, **representativeness** refers to the spaces of occurrence of the events, which for the purposes of this project can be considered as biome or ecosystem. Immediately, the anthropic indicators are representative of the Amazon biome as a geographic region in which a certain biotic and abiotic unity exists, with similar vegetation as well as climate and geology patterns, as in the case of the Amazon, in which its equatorial location implies a great incidence of solar energy that makes the climate hot and humid, with high precipitation that generates high unity and favors enormous biodiversity and forest vegetation mass, as well as water volume that floods vast plains and is thrown into the ocean, transforming the Amazon coast into a fishing production powerhouse. But, beyond the geographic and encompassing unity of the Amazon biome, it must be emphasized that the indicators, in order to be representative of the diversity of the biome, must focus more particularly on the ecosystems, these being functional units of the biome, in which biotic factors, which include all types of living beings, interact with abiotic factors, forming food chains, terrestrial and aquatic, with a hierarchy among producers, consumers, and decomposers. The ecosystems of the Amazon biome can vary, mainly due to anthropization. In the Amazon there are at least nine ecosystems: terra firme forests, igapó forests, floodable fields, saline fields, foodplains, savannas, mangroves and restingas, beaches, and mountains. Because of this diversity and considering that it is at the ecosystem level where economic production and

work are organized, as well as where Amazonian population communities are settled, the indicators must be representative of these particularities of the biome, or ecosystem communities.

### 2.1 The informants

As a general organizational category of these ecosystem communities, one can consider “people” as the collective bond of Amazonian territoriality, marked by common language, history, customs, interests and traditions; in short, an identification of a more regional spectrum, a characterization that is more appropriate to the concept of traditional Amazonian people. The hypothesis is that the category traditional people is more related to the consideration of the Good Living and the search for the sustainability of ecosystems. The Good Living is understood as the harmonious relationship between humans and nature, with a more communitarian lifestyle of shared responsibilities and collective production. In this lifestyle, the distribution of wealth takes place according to the needs of the community members (ACOSTA, 2016). It should be considered that the community style only makes sense, in a contemporary world of networked relations, when intercommunity networks are established, as an urban-rural continuum, of exercising intercultural practices. One must also consider that in Decree 6040/2007, which established in Brazil the National Policy for Sustainable Development of Traditional Peoples and Communities (PNPCT, in Portuguese), the term that became established was traditional peoples and communities, instead of traditional populations. This is how the Decree discriminates them, in its article 3, item I:

Traditional Peoples and Communities: culturally differentiated groups that recognize themselves as such, that have their own forms of social organization, that occupy and use territories and natural resources as a condition for their cultural, social, religious, ancestral and economic reproduction, using knowledge, innovations and practices generated and transmitted by tradition (BRASIL, Decree 6.040/2007) (free translate).

The corpus of the initial research was determined based on the various ecosystems of the Amazon biome, particularly ecosystems where human groups of traditional communities/conservation units occur. In order to better control the universe of informants, the concept of mesoregion (geopolitical and economic cutout) was considered to delimit the concept of ecosystem. In this first stage of the project, which took place in 2019 and 2020,

the ecosystems addressed were: a) mangrove, floodplain, terra firme forest and secondary forests, in the State of Pará; and b) floodplain and terra firme forest, in the State of Amazonas, with the application of a questionnaire to 23 (twenty-three) informants, chosen at random, but considering their interest in participating in the research. The field research was conducted by the Graduate Programs in Anthropropic Studies in Amazonia (PPGEAA/UFPA, in Portuguese) and Interdisciplinary in Human Sciences (PPGICH/UEA<sup>1</sup>, in Portuguese).

In general, the corpus had/should have the following profile:

a) informants should live and work in the same ecosystem;

b) the research units should be the households, that is, living spaces in which there is an individual or group of individuals with financial autonomy and economic sustainability and parental/grandparental identification of the informants. The households must be located in communities, which are understood as a group of individuals organized in society, under the same ethical and behavioral norms, obedient to a leadership marked by one or more individuals with historical and social hegemony, and who establishes for the others, the identity and identification with the same historical and cultural legacy. In this sense, the community corresponds to the nation, as “a society that occupies a given territory and includes a sense of identity, history, and common destiny” (JOHNSON, 1997, p. 157). The community considered here can also be the biocenosis, that is, from the point of view of ecology it is the set of living organisms that share the same ecosystem and live in relatively close proximity, constituting small villages or hamlets with dwellings that communicate with each other almost daily;

c) the percentage should be of up to 10% of ecosystem users in each community to be surveyed, which may also be the territory of conservation units. This percentage refers to households, in which the users are residents. The preferred territories for collection were the conservation units or territories used and inhabited by traditional peoples and communities with a view to sustainability. There may be one or more interviewees in the survey, but there will be only one questionnaire per household. The interviewees had a minimum age of 18 (legal age of civil capacity);

d) consider gender equity in the corpus of informants, without absolute prevalence of one gender over the other;

e) to have lived in the community for at least five (5) years, as we consider that even the non-native inhabitants may have already adapted to the practices and values of the community during this period, in such a way as to have property about the local reality as extractivists from the region under investigation.

## 2.1 The form

After delimiting the corpus of informants, we will deal with the instrument for collecting the native peoples' impressions about the ecosystems. The applied form<sup>2</sup> is composed of 180 questions, which were divided into the following main questions, with 60 questions per axis:

1) Axis 1 – HUMAN REASONS, referring to the questioning: “what are the human needs (basic or “invented”) for us to have a balanced living between human and environment and between different social groups users of the same ecosystem?”

2) Axis 2 – ENVIRONMENTAL CONSEQUENCES, related to the question: “what are the impacts on the environment and social inequalities among groups in contact within the same territory (biome and ecosystem) that meeting these human needs may provoke?”

3) Axis 3 – SUSTAINABILITY AND GOOD LIVING, referring to the question: “what initiatives (we) promote to balance human differences (social and cultural) and minimize the environmental imbalances resulting from these contacts?”

These axes reproduce the sequence of a narrative syntagma, which is the logical path for the fulfillment of the desire (and its object of desire as a search for the fulfillment of its needs) by a subject, since

the narrative (...) must be considered as an algorithm, that is, as a succession of statements whose predicate-functions linguistically simulate a set of goal-oriented behaviors (...): the behaviors presented therein maintain between them relations of anteriority and posterity (Greimas, 1973, p. 63) (free translate).

This algorithmic character of the narrative, present in our syntagmatic axes of the questionnaire, can

<sup>1</sup> We thank Prof. Edilza Laray de Jesus and the student Alana Patrícia Pires de Oliveira Alano, both from PPGICH/UEA, for their performance in the field research, carried out in the community of Careiro da Várzea, Amazonas, making it possible to have data from the riparian ecosystem to compose the anthropic indicator indexes.

<sup>2</sup> We use this concept because the instrument is marked by pre-established questions with closed answers on a scale of values, unlike the questionnaire that implies closed questions, but open answers. Also in the form, the interview is face-to-face, with direct dialogue between researcher and interviewee.

be observed in the following example. Regarding the theme “Community”, from Axis 1 – Human Reasons, it can be stated that in the question “Is your community well taken care of?” there is a relation of posterity with the question “Are there trees in your community older than 30 years?”, from the theme Bioindicators, from Axis 2 – Environmental Consequences. This occurs because the actions of Axis 1 depict behaviors of anteriority, of the interviewee and his community, which imply consequences a posteriori, because how the interviewee takes care of his community may result in the existence of older trees and in full productivity, such as the bacuri tree (*Platonia insignis*), an Amazonian fruit that begins its productivity no earlier than 12 years. In short, the Anthropic Indicators are structured in a narrative temporal dimension, in which functions (the informant's character) and actions (what the informant saw and produced) build a syntactic logic based on the informant's discourse (point of view), which is why the informant values the event, condition, or practice from 0.0 to 4.0 points, according to his/her impression and experience.

Each axis has the following specific themes, as unfolding:

1) **AXIS 1 – HUMAN REASONS:** 1) Education; 2) Safety and Tolerance; 3) Health and Food; 4) Community; 5) Work/Occupation and Income/Consumption; 6) Communication and Social Interaction;

2) **AXIS 2 – ENVIRONMENTAL CONSEQUENCES:** 1) Bioindicators; 2) Geoindicators; 3) Body Semiotics; 4) Environmental Semiotics; 5) Economic Activity; 6) Citizenship and Power Relations;

3) **AXIS 3 – SUSTAINABILITY AND GOOD LIVING:** 1) Housing Quality; 2) Environmental and Patrimonial Management; 3) Circular Economy; 4) Local Development; 5) Innovation and Use of Heritage; 6) Good Living.

The informant’s evaluation is on a scale of 0 to 4 points, relative to each question disposed in the theme referring to the axis. In total, there are 5 options/points in the answer scale (Likert scale), since this variety of options provides better precision and amplitude as to the respondent's opinion, and each point is relative to the following condition of OCCURRENCE and FREQUENCY, arranged according to Table 1.

Table 1 Informant Assessment

<p><b>A – OCCURRENCE</b></p> <p>informant’s impression regarding the occurrence or non-occurrence of the condition, practice or event.</p>
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<p><b>DO NOT EXIST: 0.0</b></p> <p>NEVER (no occurrence; no information; unknown)</p>	<p><b>EXISTS: 1.0 to 4.0</b></p> <p>approximate number of times the phenomena occur</p>		
<p><b>B – FREQUENCY</b></p> <p>the informant’s impression of the intensity of occurrence of the condition, practice, or event in the approximate 5-year cycle.</p>			
<p>1.0 – ALMOST NEVER</p> <p>(25% of the time)</p>	<p>2.0 – MORE OR LESS</p> <p>(50% of the time)</p>	<p>3.0 – ALMOST ALWAYS</p> <p>(75% of the time)</p>	<p>4.0 – ALWAYS</p> <p>(100% of the time)</p>

The two spatial-temporal magnitudes – occurrence and frequency – are consequential, since the value zero implies that the condition, practice or event has never occurred or there is no information that it has already occurred. From score 1.0 to 4.0 the phenomena have already occurred, but at different intensities of occurrence, depending on the informant's impression.

The increasing quantitative numbering (1-4) refers to the lesser (1.0) or greater (4.0) anthropization arising from human interventions to transform the environment, whether constructive or destructive, according to The increasing quantitative numbering (1-4) refers to the lesser (1.0) or greater (4.0) anthropization arising from human interventions to transform the environment, whether constructive or destructive, according to the values attributed by the informants according to their experience and impression. Therefore, the closer to the maximum value the greater will be the record of human intervention to ensure survival. Inversely, the closer to zero, the greater the absence of the human factor of transformation, whether due to the inexistence of the transforming event or the informant's lack of knowledge that it occurs. The valuation is in relation to the total number of times that the informant observed the occurrence of the event, condition or practice in his experience as a resident and/or user of the ecosystem, in a certain period of time of his free choice and attribution.

**2.1 The AHP (Analytic Hierarchy Process) method**

A multicriteria decision problem, as is the case of the extensive form of anthropic indicators, consists of a situation in which there are at least two alternative choices, and this choice is conducted to meet several criteria, often conflicting among themselves. The multicriteria approach has as a characteristic several actors involved, as in our applied research, who must define the relevant aspects characteristic of a complex decision process with each

actor having their own value judgment and recognizing the limits of objectivity, considering their subjectivities (Gomes, 2000). To build the decision model that will represent the decision problem to be addressed, multicriteria decision support models are used (Vasconcelos, 2013), as they are fundamental in the analysis and structuring of multicriteria decision problems.

AHP is a methodology focused on the solution of choice problems, applied to several situations in which complex decision structures exist (Saaty, 1990). It is widely applied in several areas, such as, evaluation of urban renewal proposals (Lee and Chan, 208), analysis of areas and communities for Sustainable Ecotourism (economic, social and environmental) (Asadpourian, 2020), analysis of the company and employee’s relationship (Serrano-Cinca, 2021), Industry 4.0 (Çalik, 2021), among others.

The differential of the AHP method is to enable the expert or user to intuitively assign relative weights to multiple criteria or multiple alternatives for a given criterion, while performing a pairwise comparison between them. This allows that even when two variables are incomparable with the knowledge and experience of experts in the field, one can recognize which of the criteria is more important (Saaty, 1991). For more detailed information on other decision-making models, we recommend reading the works (Massam, 1988), (Zeleny, 2012).

For the choice of the AHP we started from the general systems theory (GST), as an epistemology that provides two aspects that justify the choice: first, it is in accordance with our interdisciplinary perspective in the construction and application of anthropic indicators and, second, it provides the vision of an open system, since the indicators treated here are a set of variables shaped according to the application objectives for each proposal or project that uses them. This is because we propose with our indicators a modeling that aims to discriminate the intensity of anthropization of the environments (ecosystems) from the valuation given by users/inhabitants, with this objective disposing the

functions of the elements of the system – in this case the axes and themes related to each axis – glimpsing the circumstantial behavior of this system.

In our particular system is the set of indicators, which is configured as open because it starts from an interdisciplinary principle: like the functional syntax of the narrative (area of Letters), already seen as an algorithm (or algorithm) and bearer of “a logical sequence of nuclei, united among themselves by a relation of solidarity” (BARTHES, 1973, p. 39 ), we seek to ally this principle to the conception of open system of TGS (Computing area), since in both there are the characteristics of the systemic paradigm – entropy, feedback, causality, equifinality (Bertalanffy, 1986) –, in which the stimulus from the outside environment, seen as the variety of informants in our indicators can cause the adjustment and recurrent stability of the system, in conformation to be defined in the cutout of the object (see cutout of indicators in Table 2) to be applied the AHP, since this is a procedural method used to identify the relevance of the indicators and the degree of anthropization of the community, according to the general opinion of the informants.

### III. RESULTS AND DISCUSSION

The results were obtained by cutting out the corpus, since analyzing all 180 answers from 23 informants would not fit the purpose of this initial study. Therefore, for the results and discussion, presented here, we opted for a cut in the three axes – Human Reasons, Environmental Consequences and Sustainability and Good Living – considering three themes, one per axis, namely: Education (Axis 1), Bioindicators (Axis 2) and Territorial and Heritage Management (Axis 3). The results are shown in Table 2.

Table 2 Demonstrative of questions by axes and themes: Human Reasons, Environmental Consequences, and Sustainability and the Good Living

AXIS 1: HUMAN REASONS					
SCORE	0	1	2	3	4
THEME: EDUCATION					
Does what is taught at school serve the community?	6	1	6	2	8
	26.1%	4.35%	26.1%	8.70%	34.80%



Does the school take advantage of the community’s knowledge?	7	1	2	5	8
	30.45%	4.35%	8.70%	21.70%	34.80%
Are technological resources and the Internet used in the classes?	6	5	7	3	2
	26.10%	21.75%	30.45%	13.05%	8.70%

AXIS 2: ENVIRONMENTAL CONSEQUENCES					
SCORE	0	1	2	3	4
THEME: BIOINDICATORS					
Are there trees older than 30 years in the community?	0	0	0	3	20
	0%	0%	0%	13.00%	87.00%
Is the quality and quantity of the fish stable?	3	4	4	3	9
	13.00%	17.40%	17.40%	13.10%	39.10%
Are the flocks of birds disappearing lately?	3	3	5	4	8
	13.05%	13.05%	21.70%	17.40%	34.80%

AXIS 3: SUSTAINABILITY AND GOOD LIVING					
SCORE	0	1	2	3	4
THEME: ENVIRONMENTAL AND PATRIMONIAL MANAGEMENT					
Does the community respect the places where use and circulation are prohibited?	3	1	2	2	15
	13.05%	4.35%	8.70%	8.70%	65.25%
Is there supervision of the environmental and patrimonial impacts by the community?	11	6	1	3	2
	47.80%	26.10%	4.35%	13.05%	8.70%
Does the community plan the use of its territory?	10	0	6	6	1
	43.50%	0%	26.10%	26.10%	4.35%

Observing Table 2, we clarify that the second row of each Axis deals with the score from 0.0 to 4.0 points, which correspond to the informant’s impression; following the fourth row, referring to the questions, there are the absolute numbers of respondents (23 informants) of each score assigned, above, and just below the corresponding percentage (the sum should be 100% or close to it) to this absolute number, for each score.

In this cut, identified above, we obtained 9 answers for each of the 23 informants, totaling 201 answers, which are shown in Table 3.

Table 3 Total answers obtained

Score	Total Answers	Percentage (%)
0	43	21.50
1	21	10.50

2	33	16.50
3	31	15.50
4	73	36.00

The first result of the analysis of the material points out that there is some equity between the lowest and the highest anthropization – 0 points with 21.50% of the answers and 4 points with 36.0% of the answers – the first of these being understood as greater conservation and preservation of the environment and the second implying greater environmental impact resulting from human activities.

Because of this more general result of our investigation, we will dwell on the second result, which is the most thorough analysis of the corpus. This implies that

in the analysis of the narrative algorithm, as a succession of statements that simulate behaviors oriented towards an end, we can correlate the Axes and Themes in order of anteriority and posteriority. Thus, in relation to the Themes Education (Axis 1) and Bioindicators (Axis 2) there is the following correlation:

a) The question “Does what is taught at school serve the community?” presents 56.55% of answers that indicate the failure of school curricula by not reflecting the immediate needs of the community, since this percentage corresponds to the answers in the range of NEVER – ALMOST NEVER – MORE OR LESS. As a possible result of this fact, a large part of the answers for “Is the quality and quantity of fish stable?” presents a worrying percentage of 47.80% of answers in the same 0–2-point range. Since we are dealing with traditional peoples and communities, whose food is also based on fishing, the decrease in fish stocks implies the impoverished survival of native communities, which should be immediately warned in school during the basic training of the community members, as a way of raising awareness and making decisions for better public policies;

b) The question “Does the school take advantage of the community’s knowledge?” shows a balance between the lowest level of anthropization – 30.40% for NEVER – and the highest level of anthropization – 34.80% for ALWAYS – and in the intermediate ranges of 34.75%, which represents a certain balance in thirds regarding the presence of local knowledge in school curricula. However, the question “Are there trees older than 30 years in the community?” points to the need to expand the presence of local knowledge, phenomena, and events, since 87.00% of the answers pointed to the existence of old trees ALWAYS. Now, knowing the inflection point of the communities investigated, it is urgent that the local reality be a constant in school approaches;

c) The question “Are technological resources and the Internet used in the classes?” obtained almost half (47.85%) of the answers in the range NEVER – ALMOST NEVER, which means that the students are disconnected from scientific information that can help them understand what happens as a result of the question “Are the flocks of birds disappearing lately?” 52.20% of the respondents claimed that birds ALMOST ALWAYS – ALWAYS have disappeared. This is because there is a website specialized in monitoring migratory and wading birds, BirdLife, which works in conjunction with Save Brasil, and both are responsible for research and conservation actions for these animals. Besides, when there is access to technological resources, it seems to be limited, since 30.45% of the respondents alleged that there is MORE or LESS availability of these resources: maybe due to limited

equipment and Internet access, maybe due to managerial incompetence for the use of the resources, maybe due to lack of knowledge of the network’s potential.

We observed that as a logical derivation of the previous Axes, Axis 3 – SUSTAINABILITY AND GOOD LIVING, in the theme Environmental and Patrimonial Management, presented the following:

d) In the question “Is there supervision of the environmental and patrimonial impacts by the community?” close to half of the informants (47.8%) claimed that it NEVER occurs; and the great majority remained in the range NEVER – ALMOST NEVER – MORE OR LESS: (78.24%), which denotes an absence of community proactivity in relation to the factors that can substantially harm the survival of an extractive community;

e) In the question “Does the community plan the use of the territory?”, 43.50% of the informants alleged that NEVER, which added to the 26.1% that answered MORE OR LESS, gives us the worrying picture that the sustainable use of the environment is not in focus, which compromises the sense of sustainability as the use of the environment without compromising it for future generations.

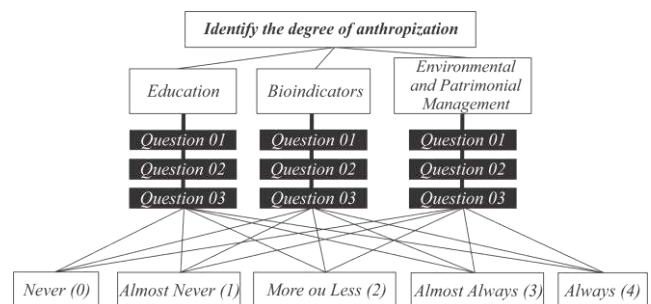


Fig.1 AHP Hierarchy

The AHP was used as a complementary method to determine the ranking of factors competing with positive or negative anthropization, thus justifying the choice of the most important themes in measuring the values attributed by the informants. The AHP calculations were made using the MATLAB<sup>3</sup> tool, due to its capillarity in solutions of the same nature. Fig. 1 illustrates how the problem was hierarchically organized, with the three axes and three questions for each, totaling the 09 questions representing the criteria, and the alternatives being anthropization values (0-4).

For applying the AHP, determining the comparative criteria matrix is the first step. Determining the criteria that will be used in the choice of alternatives

<sup>3</sup> <https://www.mathworks.com/products/matlab.html>

for decision making is the first part for using the AHP. After defining the criteria, the comparative criteria matrix is assembled, taking into consideration the rule suggested by (Saaty, 1991), the matrix is filled by comparing the criteria that appear in the left column against the characteristics that appear in the top row.

The evaluation of the experts or users corresponds to the answers to two questions: which of the two metrics is more important with respect to a top-level criterion, and with what intensity, using the 1-9 scale (Saaty, 1990). The values established by the experts through peer review in this work are presented in Table 4.

To interpret and give the relative weights to each criterion, the second step, it is necessary to normalize the comparative matrix. The normalization is done by dividing each value in the spreadsheet with the total of each column. Next, the Eigen vector is calculated, which will present the relative weights among the criteria and will be obtained approximately through the arithmetic mean of the values of each criterion. With the conclusion of this step the weights of each criterion are obtained (0.274, 0.271, 0.180, 0.104, 0.079, 0.032, 0.024, 0.020, 0.017).

Table 5 consists of the alternatives and criteria, with each criterion having its weight defined by the specialist in the decision area (in this work we will use the weights generated by the AHP).

The results of the two techniques – percentage and AHP – were equal in relation to the degree of anthropization of the community, with emphasis on grade 4, which obtained the highest percentage in the AHP (35%) The overall ranking was as shown in Table 6.

With the technique we conclude that as the populations investigated are at a threshold point between the harmonious and sustainable relationship with the environment, on the one hand, and on the other hand the exploitation and environmental degradation, that is, this apparent balance between positive anthropization (sustainable) or negative anthropization (degradable) demonstrates the turning point in the survival and sustainability of populations and ecosystems surveyed, as to say that there is time to conduct the search for a state of equilibrium. This is even what the Report United Nations Intergovernmental Panel on Climate Change (IPCC) says, in its 2021 version, which points out the determining role of human influence on global warming. Reaching a balance of a median index in our indicators can provide, based on the numbers, the construction of a series of initiatives in which consumption is not totally abhorred and the bankruptcy of life and of the planet is not decreed due to social vulnerability, income inequality, pollution, and deforestation, but that we can propose “sustainable” human development aimed at equitable social progress.

Table 4 Pairwise Comparison Matrix

	P. 01	P. 02	P. 03	P. 04	P. 05	P. 06	P. 07	P. 08	P. 09
P. 01	1	1	2	6	6	6	9	9	9
P. 02	1	1	2	3	9	9	7	9	9
P. 03	1/2	1/2	1	5	3	7	6	6	6
P. 04	1/6	1/3	1/5	1	3	3	7	7	7
P. 05	1/6	1/6	1/3	1/3	1	3	7	7	7
P. 06	1/6	1/9	1/7	1/3	1/3	1	2	2	2
P. 07	1/9	1/7	1/6	1/7	1/7	1/2	1	2	2
P. 08	1/9	1/9	1/6	1/7	1/7	1/2	1/2	1	2
P. 09	1/9	1/9	1/6	1/7	1/7	1/2	1/2	1/2	1

Table 5 Matrix of Alternatives and Criteria

	P. 01	P. 02	P. 03	P. 04	P. 05	P. 06	P. 07	P. 08	P. 09
Alternative 0	6	7	6	0	3	3	3	11	10
Alternative 1	1	1	5	0	4	3	1	6	0
Alternative 2	6	2	7	0	4	5	2	1	6
Alternative 3	2	5	3	3	3	4	2	3	6
Alternative 4	8	8	2	20	9	8	15	1	1

Table 6 Ranking obtained by applying the AHP

Score	Ranking using AHP
4	1 <sup>st</sup> (35%)
0	2 <sup>nd</sup> (24%)
2	3 <sup>rd</sup> (18%)
3	4 <sup>th</sup> (14%)
1	5 <sup>th</sup> (9%)

#### IV. CONCLUSION

The objective of the Anthropic Indicators proposal is to produce an indicator that shows indices revealing the state of anthropization of traditional peoples and communities, or autochthonous communities, according to their experiences and impressions about events, conditions, and practices of their daily lives in relation to the ecosystems in which they operate. By translating the experiences and impressions into numerical values that explain the occurrence and frequency of events, conditions, and practices, the informants point out their reasons for having a certain human need, which can imply consequences to the environment, in a gradient that goes from occupation, exploitation, expansion, and degradation – negative impacts – on the one hand, to regeneration, occupation, protection, conservation, and preservation on the other hand, in this case in a perspective of seeking sustainability and the good living.

As much as this initial study is more focused on presenting the anthropic indicators method, we cannot fail to mention that the delimited problem-questions for each Axis were partially answered:

1) “what are the human needs (basic or “invented”) for us to have a balanced living between human and environment and between the different social groups users of the same ecosystem?” – we present the Theme Education as one of the human reasons to have the production of culture, it is as a set of human production that ensures the fixation in a certain environment (ecosystem). Certainly, knowing the space is a sine qua non condition for anthropization to occur, and this knowledge is given through educational transfer, which must have the quality to ensure an inclusive education of people and knowledge, which was not revealed by the informants;

2) “what impacts on the environment and what social inequalities, between groups in contact in the same territory (biome and ecosystem), can the fulfillment of these human needs provoke?” – the Theme Bioindicators showed that communities are fully unaware of the space in which they live and work, which compromises better management of fishery resources and natural services on their behalf, whether it is the control of plant species or the bioindicator service that waders and migratory birds can offer to these communities;

3) “what initiatives do (we) promote to balance human differences (social and cultural) and minimize the environmental imbalances that result from these contacts?” - the Theme Environmental Management revealed the communities’ total unpreparedness regarding the need for territorial, environmental, and patrimonial management as a guarantee of sustainability for today and for future generations.

But our main objective with this study was obviously to confirm the validity, reliability and methodological representativeness of the indicators, because the results could determine a tool that is suitable for measuring the events, conditions and practices of the users of the ecosystems investigated in the Amazon biome, having the voice and the turn of those who historically have had their discourse excluded from the indicators responsible for leveraging public policies that are directed to indigenous populations. In addition, the reliability of the occurrences and their frequencies can be more legitimate, since it is a matter of valuation according to the impression of the agents and direct patients of the ecosystemic events, with the coverage being representative of local social actors.

Finally, with this tool of anthropic indicators we can understand that anthropization more than a pejorative concept is a way to relativize the human presence in the environment, without neglecting that this presence causes profound changes that lead to configure it as a new geological era, the Anthropocene, but that is necessary, because otherwise we would return to a prehistory, in which humans would not have much chance of survival.

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## Health care organizations: How to achieve excellence in care?

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**Abstract**— *Health care organizations have a duty to provide quality care to their users and to consider patient safety as a first. However, there are several elements to consider as essential for achieving excellence in service, which will be discussed in this work. As an objective, the present study seeks to list the main elements that contribute to an organization of health care to have excellence in the provision of its services and, to deepen the discussion about the alignment and cohesion of the teams. Methodologically, this is a qualitative, exploratory and bibliographic*

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**Keywords— Excellence, Health Organizations, Team Training.**

*research, in which a bibliographic review of the last five years was carried out in scientific articles and reference sites, analyzed in January 2022, using the following descriptors: organizations of health, excellence, evidence-based medicine and team training. As a result, it can be seen that health organizations need to retain their employees so that they are co-responsible for the success or not of the organization. Through the feeling of belonging, empowerment and horizontality, this loyalty occurs more naturally and the members of the group start to always act in search of the best, of excellence in service to their customers.*

## I. INTRODUCTION

Thinking about a health service of excellence goes far beyond a place with a good physical structure and cutting-edge technologies to services for employees and patients. Knowing how to make the best use of all the available apparatus and having a cohesive and well-aligned team are essential for the quality of the services provided and, consequently, the success of the health organization.

Achieving excellence in a health service requires that several elements be considered by managers, among them we can mention:

- 1) Balanced, trained, assisted and rewarded teams;
- 2) Aligned and integrated teams;
- 3) Common culture for alignment and integration;
- 4) Process and rules infrastructure as a facilitator of solutions to complex problems;
- 5) Infrastructure that keeps the organization's mission aligned with the needs of the stakeholders;
- 6) Continuous improvement processes.

As an example of success using this range of fundamental elements, we can mention Mercy Health - an important North American health care organization - which annually stands out for presenting excellent services aimed at quality, exceptional service, a good environment to work in. and at the same time develop strategies to minimize costs and keep delivering efficient services" [1].

Understanding how a company can successfully reach and remain in the market and in a continuous process of expansion is an important challenge and at the same time fundamental to obtain similar results.

Given the context presented, this paper aims to discuss the main elements that contribute to a health care organization presenting excellence in the provision of its services, with emphasis on aligned and integrated teams.

## II. METHODOLOGY

Methodologically, this is a qualitative, exploratory, bibliographic research, in which a bibliographic review of

the last five years was carried out on scientific articles in the Virtual Health Library database and on reference sites, analyzed in January 2022, using the following descriptors: health organizations, excellence and team training.

Thirty-five articles were found, and after applying the eligibility criteria: full text, in Portuguese and indexed, the abstracts were read and the studies that met the theme related to the object of study were selected. Here, the discussions of the three most relevant works in this context will be presented, in addition to the considerations of a reference site also considered relevant.

## III. RESULTS AND DISCUSSION

### 3.1 Excellence in providing care

Increasingly, customers of healthcare organizations are looking for effective, humane services that prioritize their safety. In the meantime, Freire [2] notes that quality has become "an essential item for attractiveness and customer loyalty, also having the purpose of increasing the financial return of institutions and reducing waste".

Excellence translates as quality to the highest degree, with primacy over all. But is it possible to obtain this excellence in a health service? Considering its high complexity and the involvement of different teams? Undoubtedly this is an arduous and constant task, but not impossible!

Every improvement was caused by dissatisfaction. Thus, in order to have, and especially to maintain, a service of excellence, it is essential to maintain a certain climate of dissatisfaction, which can also be translated as chronically worried, with certain restlessness. This climate is necessary, but there is a need for a balance between dissatisfaction and action here [3].

Dissatisfaction alone does not lead to improvement, it needs to be balanced and go hand in hand with the right action at the right time and the right people involved and committed to the whole.

### 3.2 Aligned and integrated teams

An indispensable element is to have the teams aligned and integrated. In health, there are several professional categories working together. However, communication failures and effective partnerships often interfere with the routine of the service and ultimately reflect on the quality of care provided to the patient.

Study developed by Marques [4] states that “team meetings represent spaces for integration and alignment of the work process, including the planning of pilot study activities, as well as continuing education activities”.

It is clear then that spaces for joint assessment of work processes are important tools for communication and team cohesion.

The meetings configured moments of encounter, of being together to identify knowledge gaps and insecurities to be overcome based on the mutual and interdisciplinary relationship of help. Thus, collaborative work between professionals became a tool that helped in the processes of permanent education in health and in the strengthening of the team, positively reflecting on the integration, scope and effectiveness of collective activities [4].

Absenteeism and turnover are observed in the health area as outstanding characteristics and it is usually believed that this is linked only to salary conditions and work overload. However, Ferreira and Reis [3] show that the increase in salary not linked to the change in organizational culture causes transitory motivation. Therefore, this would not be the best solution for team loyalty.

[...] incentives that bring gifts, travel or other financial rewards often lead to a climate of competition. Destroying the collaboration environment. [...] And so, if this is a very competitive environment, we cannot achieve our objective [...] due to the anxiety generated by the excess of competitiveness. Collaborative environments are often associated with the best experiences for all participants [3].

So how do you change the way people perceive your work? The watchword here is belonging. In order to develop good teamwork, it is necessary for its members to feel that they are an important and fundamental part of the whole.

Costa et al. and Fortuna et al. (as cited in Marques [4]) point out that “good communication, bonding and cooperation between the members is also essential, as well as commitment, co-responsibility and moments of sharing, elements that make mutual learning possible.

Experiencing group activities is a way of integrating professionals, obtaining a shared education and, thus, promoting a change in organizational culture. Another

important factor that acts greatly in relation to the change of culture is horizontality. Marques [4] assures that “horizontal care seems to favor care more than the vertical approach, as this [...] has generated low user attachment and adherence to programs and treatments, in addition to professionals' frustration”.

We can cite Disney as a successful experience on horizontality. In the work of Ferreira and Reis [3] he takes this approach to the success of the Disney Organization: “one of the challenges that Disney overcame in the 1980s was to delegate more power to employees. At Disney, collaborators are called cast members. Another way of valuing and motivating everyone who works at the institution”.

In this same work, Ferreira and Reis [3] states that any employee who works in contact with customers has the power to reimburse, give gifts or solve any problem that the customer has within the parks, all to satisfy and retain customers. In addition to accelerating problem solving, it gives employees a sense of belonging and empowerment.

Transcending to the reality of health, Ferreira and Reis [3] say that:

Clearly, giving a gift does not configure the routine of the hospital environment, but we can use the same methodology to help clients in difficulties, such as finding a wheelchair or providing a bed for an elderly companion, or seeking material for a professional in attendance.

Like the examples above, there are numerous attitudes and actions that can and should be implemented in a health care environment and that will facilitate the daily routine, igniting a sense of belonging on the part of the employee, as well as aiming to provide more prompt and quality service to the patients.

It is worth mentioning that the involvement of the top management of the health care organization is essential for aligning the purposes of quality with the strategic objectives of the institution. In this way, tactics are developed and implemented in the daily life of health services to achieve and maintain excellence, requiring constant review in order to promote continuous improvements and process consolidation [2].

## IV. CONCLUSION

A health care organization, despite having state-of-the-art technologies and the best physical structures, will hardly achieve success and excellence in customer service if its employees are not engaged and cohesive.

Empowerment, horizontality and belonging are fundamental concepts that must be present in the practice



of health teams. As discussed here, these are the ones that will guide the change in organizational culture, building employee loyalty and bringing excellence as a precept to the company's life, not as something unattainable, but as something natural in its daily life.

It is therefore up to managers to seek strategies for cohesion and team loyalty and adherence to the change in organizational culture, which will directly affect the improvement of desired organizational results.

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## The use of Instruments that Facilitate understanding and Correct Analysis of Indicators in Hospital Management: An Integrative Literature Review

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**Keywords—** Hospital management, Health indicators, Management instruments.

**Abstract—** The aim of this study is to analyze whether there is an instrument that can facilitate the understanding and correct analysis of indicators in hospital management. The Strategic planning methodology in the Balanced Score Card (BSC) method, started in 1990 by professors Robert Kaplan and David Norton with a research project in the corporate world, which ended up being used and adapted for public administration. The management indicators, directly interfere in the institution's planning, a result provided by the indicators, allow for a critical analysis of the data and later the deployment of corrective, preventive or improvement action plans. It is a descriptive study and developed through an integrative literature review (RIL) where no production was found that demonstrated any instrument used to guide the manager to understand the indicators, the articles found, point to the need for education permanent, it was evidenced that although the majority of the managers affirm that they understand the indicators, they make little use of the information for decision purposes in their management, it was also stated that the lack of time contributes to the team not complying with the collection and analysis routine indicators. It is necessary to innovate management, looking for tools to evaluate and monitor its indicators.

## I. INTRODUCTION

In the health area, it has always sought to introduce managerial innovations, with new methodologies, tools and technologies aimed at the quality of the service or care offered, since it is an area considered relevant for innovation, being the most responsible in the world, for the development of research. According to Machado et al (2012) “The role of health is recognized as an essential factor for the citizenship conditions of the population and as a structuring element of the social welfare state”.

According to the Interagency Health Information Network – RIPSAs “If generated on a regular basis and managed in a dynamic system, indicators are valuable tools for the management and assessment of the health situation at all levels”. The result provided by the indicators allows for a critical analysis of the data and later the deployment of corrective, preventive or improvement action plans. For Takashina (1999) indicators are “quantifiable representations of the characteristics of products and processes, thus being used to improve the quality and performance of a product, service or process over time”.

For Kaplan, Robert S (2004) “You cannot manage what you cannot measure” and “You cannot measure what you cannot describe”, that is why it is so important to analyze the use of indicators by managers and what is their level of knowledge about the correct interpretation of this tool. This study is important to seek information on institutions that use the indicators to support decision-making based on effective knowledge and their use by health managers, who are primarily responsible for decision-making and the management of their management team.

It is important that any health management encourages the use of indicators at all levels, which improve their results and favor the debate about them and their impact on the lives of citizens. According to Bernardo (2016) “It is necessary to consolidate the use of quality methodologies in health services, trying to evaluate the before and after the intervention, obtaining an overview of management progress.

Management indicators directly interfere in the institution's planning, because for Rivera and Artmann, (2012) “planning is a form of management that requires the organization of actions so that they can achieve the objectives without improvising them”. It is important to reflect on the importance of something that promotes knowledge of indicators in a concrete way and how they influence decision-making to work with observed non-conformities, inserting, if necessary, new ways of

monitoring and evaluating actions based on results, positive or negative. An instrument that produces changes and has an impact on the quality of services offered to society; in the organizational climate; in the economic and financial sustainability of the organization and that can positively interfere in the organizational culture.

There is a preeminent need for investment in the intellectual capital of health institutions, as many leaders are, above all, professionals from different areas of activity and not specifically from the health area. According to Goronzi (2012) “The transition from individual employees to the condition of managers requires an enormous effort from these professionals, implying transformations that end up configuring the profile of a new professional”.

According to Colauto and Beuren (2003) “we live in a world of political, economic and social changes that affect organizations and people, and with this the need to acquire and manage human knowledge is intensified”, they also emphasize that organizations are elements relevant to the socio-economic development of a nation, by providing the achievement of collective objectives. Having a defined purpose for organizations, focuses attention on what is relevant and develops your skills to achieve your goals.

Based on this information, the objective of this study is to analyze whether there is an instrument that can facilitate the understanding and correct analysis of indicators in hospital management. Given this context and the importance of tools that seek to strengthen the strategic management process in an evident way, with the use of indicators, the relevance of the theme proposed for this research is justified.

## II. METHOD

This is a descriptive study developed through an integrative literature review (ILR). The productions were selected on the basis of Descriptors in Health Sciences (DeCS), where the descriptors were used: hospital management, health indicators and management tools. The literature search was performed in the Virtual Health Library, more specifically in the Database of Latin American and Caribbean Literature on Health Sciences (LILACS) and Scientific Electronic Library Online (SCIELO) and VHL.

As inclusion criteria, the following were used for the selection of samples: studies published in the period between 2010 and 2020, publications with texts in Portuguese, published in Brazil and whose theme contemplated institutions that use the indicators as a way of evaluating their management. In addition, the exclusion factor was defined on articles that do not include the study

of indicators. Thus, the final quantitative consisted of 15 articles produced.

Data collection was performed using a form, which was filled with articles related to the topic. Listed by: title, author and year.

Table 1: References used to prepare the RIL

TITLE	AUTHORS	YEAR
Methodology for building a panel of indicators for monitoring and evaluating SUS management	TAMAKI, M. E.; et al	2012
Use of indicators to monitor the promotion and care actions of the National Policy for Integral Attention to Men's Health (PNAISH)	MOURA, C. E.; LIMA, A. M. P.; URDANETA, M.	2012
Difficulties experienced by nurses in the use of process indicators	MENEZES, P. I. F. B.; D'INNOCENZO, M.	2013
Construction and analysis of a computational tool to calculate nursing care quality indicators	PINTO, V. R. S.	2014
Quality of care indicators: opinion of nurses Managers of teaching hospitals	ROSSANEIS, M. A.; et al	2015
The use of indicators as a management tool in the family health strategy	PAES, L. G.; et al	2015
Managers' perception of the use of Indicators in the health service	LIMA, K. W. S.; ANTUNES, F. L. J.; SILVA, Z. P.	2015
The use of care indicators system by nursing managers of a university hospital	ZANCHETA, N. B.; et al	2016
Development and validation of indicators of good patient safety practices: Project ISEP- Brazil	GAMA, Z. A. S.; et al	2016
Preparation of a booklet on health indicators as a strategy to strengthen Primary Care in the municipality of Itapevi	SIMAKAWAI, A. F.; VENANCIO, S. I.	2016
Instrument to support regional health management for monitoring health indicators	PEREIRA, B. S.; TOMAS, E.	2016
Quality indicators in primary health care in Brazil: an integrative review	FERREIRA, M. J.; et al	2017
Analysis of health indicators and their appropriation to change the practices of Primary Care professionals	SIMAKAWA, A. F.	2018
São Paulo State Department of Health Human Resources Coordination Institute of Health	SIMAKAWA, A. F	2018
Implementation of an online dashboard for patient safety	SASSO, M. A.; et al	2019

### III. RESULTS AND DISCUSSION

Of the cited references, the year 2015 had the highest number of publications with 05 productions (33.3%). The region that published the most was the Southeast region. No publications from the North region were found.

06 articles (40%) were identified that present monitoring, evaluation and information on management indicators: 02 presented electronic panels, 02 booklets and 01 computer tool in excel.

Furthermore, no references were found that demonstrated any instrument used to guide the manager to understand the indicators, their applicability and their critical interpretation. According to Bernardo et al (2016) "Health indicators need to be analyzed in order to translate numbers into quality so that the causes of problems can be identified". With this, it is essential that the manager knows how to translate his results in a clear and concise way, knowing how to explain how he behaves, how his historical series interferes with services and how it impacts on their delivery to society.

The articles found, 27% of the publications point to the need for permanent education to train managers with regard to the concepts that enable the understanding of indicators and their importance. In the health area, many managers are chosen based on their length of service and not based on their ability to hold a certain position.

It is important that there is training in professionals and that they add knowledge and invest in valuing the server as an integral being and co-participant in the changes of their time According to the Interagency Network for Health Information - RIPSAs "It is expected that the indicators can be easily analyzed and interpreted, and that they are understandable by information users, especially managers, managers and those who work in the social control of the health system".

It was evidenced, in some studies, that despite the managers claiming to understand about the indicators, they rarely use the information for decision-making purposes in their management, that is, they give little importance to this type of evaluation and thus compromise communication between their employees. led, not prioritizing what is important and what needs to reach everyone. According to Castro et al, "The manager/manager is included in the government or management group of the institution and this guarantees attributes that make him/her stand out in front of other internal or external groups and who submit to it". Making use of information that evidences the results is a criterion

inherent to a mature management with consolidated purposes.

It was also stated that the lack of time contributes to the team not complying with the routine of collecting and analyzing the indicators, many managers accumulate several functions and leave the management of their information in the background, which causes the consolidation of the culture of "putting out fires". Added to this, work overload is almost always inherent to health professionals, who often accumulate two or more employment relationships, which interferes with their commitment to management.

According to Bernardo (2016) "If monitored on a regular basis, indicators are valuable tools for evaluating the quality of health actions and services, enabling the establishment of assertive priorities through the demands identified in the analysis of the data provided".

It is a fact that indicators are useful for obtaining data and monitoring them, in addition to being the best way to identify which improvements can be implemented and which non-conformities need to be remedied. In addition, the evaluation and monitoring of indicators can become routine and, consequently, a culture within the organization.

Some managers refer to the difficulty of the institution's own commitment to be fully involved in innovative strategies. All these difficulties result in daily challenges that, according to Paiva et al (2018), are faced by managers such as: the delay in the implementation and actual use of new information technologies, resistance to innovative work management processes, infrastructure inadequate, the lack of planning of the services offered and the lack of autonomy.

The productions highlight the importance of indicators and their contribution to meeting the specific needs of each organization. According to Lima et al (2015) "The information provided by health indicators provides the necessary basis for planning, executing and evaluating the actions carried out", that is, each organization or service seeks to measure its results with indicators that demonstrate the efficiency, effectiveness or effectiveness of its services and related to aspects such as structure, processes or results.

The studies also demonstrate the absence of managers in the moments of elaboration of the indicators and that they end up finding difficulties in the development of their management. This absence often happens due to changes in management, lack of leader engagement or non-inclusion of the leader in relevant discussions. According to Oliveira (2011) "It is essential that the leader understands the environment in which he is

inserted, to understand the positive and negative impacts and ethical implications that surround him”

It was also shown that there is still no standardization in the use of indicators in some institutions and this makes the evaluation and monitoring process difficult, as well as the learning process for the entire team. For Pinto (2014) “The information system is a support for institutions to achieve goals and objectives, being considered a support instrument for the management and evaluation of patient care”. The use of monitoring and evaluation systems is an important step to ensure access and transversality of information throughout the institution.

#### IV. CONCLUSION

Thus, it is evident that there are no investments by institutions in creating instruments that facilitate the understanding and correct analysis of indicators in hospital management. The effective use of indicators is still incipient, either due to difficulty in understanding their importance or the way in which the results are analyzed.

In addition, it was observed that many professionals report not having enough time in their routine to monitor and evaluate their results through indicators. Therefore, it is necessary to understand the importance of prioritizing a routine focused on management with a focus on results, allowing everyone to be involved and thus contributing to the maturity of management in all internal processes.

Therefore, management innovation seeks tools to assess and monitor its indicators, with tools that bring managers closer to their reality and that support evidence-based decision making. Furthermore, it is important that the results are shared throughout the institution, as effective communication and transparency bring all areas together, creating a positive and productive organizational climate.

Therefore, as important as evaluating and monitoring, it is understanding the indicators and knowing how to analyze them correctly, understanding their aspects and knowing how to interpret them according to the results found. For this, it should not be done only a shallow and inconsistent reading, but demonstrating its impacts, its positive or negative trend, its historical series and evidencing the vulnerabilities and opportunities for improvement that can be achieved.

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## Perspectives of innovation in small companies in Brazil

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**Keywords—** SMEs, innovation,  
manufacturing, measurement of innovation,  
processes, greater Sao Paulo.

**Abstract—** Brazilian Small and Medium Enterprises (SMEs) represent more than 98% of the total active companies in the country in 2021. The role of process innovation should receive special attention, which leads us to write this article to measure the Dimensions of Innovation in companies today. The Innovation Radar was applied to support the tool model of the diagnostic method, which was established to perform data analysis with the needs of each organization. Through this methodology, analyzing the 12 Dimensions of Innovation, described by Mohanbir Sawhney (2006), and adapted by Bachmann & Destefani (2008), a sample of 20 SMEs from the manufacturing segment is used, in the southern region of São Paulo, which is the largest city in the Americas. The fieldwork of the research, in loco. The function was to promote recommendations and collaboration, to improve opportunities to be replicated in other organizations with similar challenges. The focus of the contributions of this work are the Dimensional Processes, since most participants presented common results, however, as a survival strategy, all of them found the need to differentiate themselves from their competitors.

Also noteworthy is the focus on the greater Sao Paulo region, an important economic hub in Latin America.

### I. INTRODUCTION

According to IBGE[1], from 1995 to 2019 the Brazilian industrial sector suffered a period of decline in participation in the GDP from 16.8% (1995) to 11% (2020), a trend that shows no signs of change and is still accentuated due to the negative consequences of the COVID19 pandemic.

Despite the unfavorable situation, the Brazilian industry is still reasonably diversified[2], producing everything from steel to aircraft, but it suffers a growing international competition in response to the growing integration of global markets.

Amid an uncertain climate of urgency and risk, it is necessary to innovate to generate long-term economic value[3]. Thus, it is becoming something fundamental to

the survival of businesses in the competitive current market.

In the world of SMEs (Small & Medium Enterprises), innovation is a challenge on small budgets. According to the Oslo Manual, produced by the Organization for Economic Cooperation and Development (OECD), the factors assisting or compromising innovation are: “the innovation process is assisted by a variety of sources of information: internal sources (within the firm), external market sources, educational and research institutions, and generally available information; innovation may be hampered by economic factors, ones relating to the enterprise, and with a miscellany of others” [4]( p. 50).

Considering the importance of the culture and practice of innovation for companies in general to survive in hyper competitive environments. This article studied and applied

a diagnostic tool (survey)[5] to measure the degree of innovation in SMEs, to disseminate and contribute to the culture of innovation as an alternative to mitigate the effects of the crisis.

The general goal of this article is to understand the influences related to improvement and innovation in the dimension processes in companies, as they affect the degree of innovation of the sample. The specific objective is to diagnose and contribute with innovation recommendations for the processes of twenty SMEs in the manufacturing segment of the southern area of the São Paulo city which is the largest city in South America.

## II. INNOVATION

According to the Oslo Manual [4], the minimum entry is that the product or process should be new (or significantly improved) for the company (it does not have to be new to the world) (p. 31). According to Facó and Mandel [6], though, innovation differs from invention because: The invention arises from a creative process, not necessarily a commercial purpose, previously defined. From the moment a new product, service, or business process reaches society and produces some result, then yes, it becomes innovation .

In The Oslo Manual, as noted by Facó[7] innovation aims to improve the performance of an organization by enhancing its competitive edge, or for maintaining their competitiveness. It can occur through development and improvements in the product mix or through new markets and/or customers. Alternatively, innovation may occur through a reduction of production[8] costs, purchasing, distribution, or transactions. Or, the company may opt for the improvement of its innovative capacity, increasing its ability to develop products and processes to acquire and create knowledge.

Individually observing each company, a customized system is noticed, with specific attributes and characteristics[9] adapted to their own needs. Thus, undertaken innovations should strengthen these differentials. They need to seek efficiencies compatible with their products, their customers, and the environment in which they operate. They need to better short-term results, tangible in nature, or most desirable, intangible. These innovations should be most apparent in the medium and long-term development of their organizations.

From the perspective taken in this study, the Dimension Process takes on an even more relevance in the world of SMEs. Since innovation can be present in processes involving a specific area of the business, such as sales, payable accounts, etc., then it can connect different

areas of the business, customers, and suppliers along the value chain. It should be emphasized that, often, the latter requires a much greater effort in terms of knowledge, Information and Communication Technologies, or ICTs [10]. Small business owners can take their first steps in search of better competitiveness through incremental innovation. This innovation may bring more immediate results because much of its competitiveness is derived from the way the organization articulates its processes. For instance, employing time, people, and space, which, in the visions of [11], [12] and [13], appear reflected on Figure 1

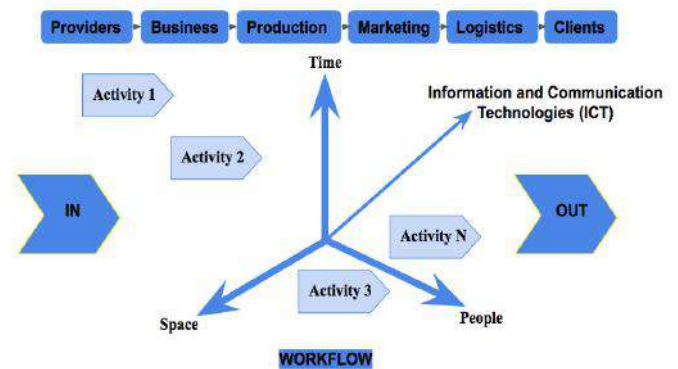


Fig. 1: Graphic representation of a process (workflow).

The effective application of ICTs, as depicted in Figure 1, tends to show that there is a noticeable reduction in three areas: space, people, and time. The application is reflected in benefits, which can translate into productivity gains and reduced costs for the benefit of the organization. The application is due to a: "(...) set of interrelated activities, time, people, and space, which receive input (data) and should generate outcomes (results) of value, whether for internal or external customers" [11] ( p. 20).

## III. METHODOLOGY: INNOVATION RADAR

There are several methodologies to try to measure innovation [5], for the purposes of this work, the innovation radar methodology which was applied was chosen.

Sawhney, Wolcorr, and Arroniz at the Kellogg School of Management [14], created the Innovation Radar used in this work, later adapted by Bachmann & Associates [15]. This tool evaluates, via a questionnaire, an SME's innovation at that moment considering features that small and medium organizations have compared to bigger organizations. In the context of SMEs, it would be inappropriate to measure innovation with aspects such as the number of Information and Communication Technologies (ICTs), investments in research and



development (R&D), as used in the Oslo Manual, since the Manual does not distinguish the size of the organizations.

According to Bachmann [16], innovation in SMEs occurs in different forms than in large companies, and therefore the method of measuring the degree of innovation should be distinct. Several studies conclude that the process of innovation management has a physical dimension, with favorable organizational structures, and an intangible dimension related to behavior, freedom of communication, risk-taking culture, and the practice of creative techniques. The model adopted, in addition to the measurement, aims to recommend improvements with action plans, along with the monitoring of continuous and personalized learning for each company.

The authors mapped and scheduled visits to the SMEs, and entrepreneurs with suitable profiles were chosen for the study. The chosen SMEs allowed the survey to be conducted within the following parameters: The enterprises were framed by the annual revenues from R\$360,000.00 to R\$3,6 million per year, in the manufacturing segment, (currently the dollar is 1 to 5.51 reais) in the southern region of São Paulo. The notion that regional factors can influence the innovative capacity of firms has led to increasing interest in analyzing innovation at the regional level [5].

The application of the diagnostic questionnaire, called the Innovation Radar, was completed on-site, at each company. The collected data has been analyzed in this article. The measurement within the Innovation Radar is not absolute, but a reference for improvements and the potential to innovate, existing in the analyzed organization.

The Innovation Radar evaluates how the environment of a business is conducive to innovation, after all, the widely accepted concept is that an innovative company trains its employees to solve problems and fosters creativity as part of the organizational culture.

To expand on Sawhney's original twelve Dimensions of Innovation, Bachmann established his perspective in an additional, new dimension: the addition of the "Innovative Ambience" dimension, directly relates to influencers' services as an external source of innovation. The Innovative Ambience dimension consists of paid consulting, development agencies, free advisory, universities, research centers, etc.

The questionnaire applies the Likert scale, which consists of three levels and scores from 1 to 5, to identify and rank companies, quantitatively. The first level denotes companies with Little or No Innovation, corresponding to the score of 1; the second level defines the Occasionally Innovative companies, and the corresponding score of 3; and the third level indicates the Systemic Innovative

companies, with a corresponding score of 5 [15]. When administering the questionnaire, only the last three years of the companies' operations [13] were taken into account. Hence, the questionnaire measured the current situation of the organizations, as actions taken before this period do not meet the criteria for present-day innovation.

The Innovation Radar was administered through formal interviews, on the spot, and done individually or with a group of decision-makers in the participating organizations. After application of this tool, data were tabulated to generate charts and graphs, showing the degree of innovation for each of the thirteen radar dimensions. The result was the overall index of the companies' innovation.

The results were later presented in the form of feedback to the heads of each organization. The points of the greatest relevance were explained in detail, in a personalized manner to each company. Table 1 exemplifies a sample table for each company, in Figure 2, a sample graph generated by the questionnaire.

*Table.1: Table generated by the Innovation Radar for a particular organization.*

Level of innovation	Average
A – Offer	3,0
B – Platform	2,0
C - Brand	3,0
D - Customers	1,7
E - Solutions	1,0
F - Relationship	2,0
G - Value	1,0
H - Processes	1,0
I - Organization	3,7
J – Supply Chain	1,3
K - Presence	2,0
L - Network	2,0
M – Innovative environment	1,3
Level of Global Innovation	1,9

Observing Table 1, the ends correspond to the highest scores in the company. In contrast, the closest points on the graph's center correspond to the least developed dimensions. These opportunities for improvement were offered to the companies' leadership teams, in hopes that they would improve on the dimensions would create the greatest impact for their companies.

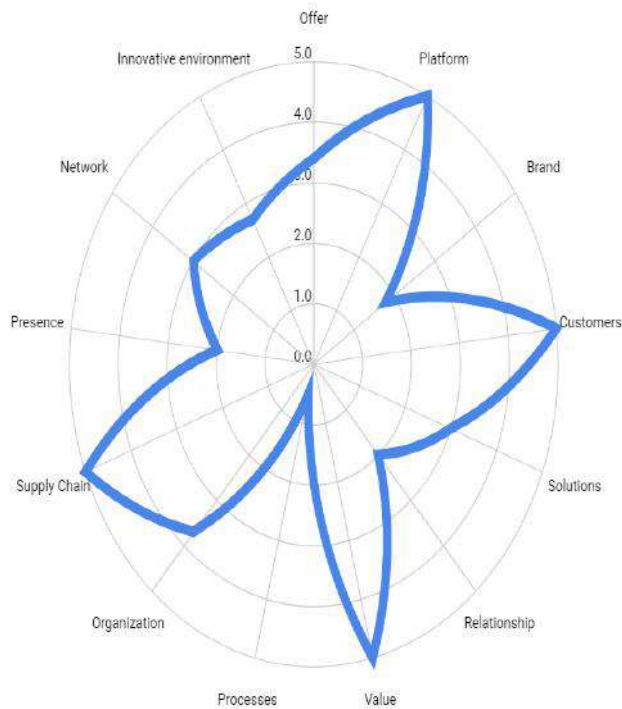


Fig. 2: Radar of Innovation generated by a particular enterprise.

Observing the averages of the set of 20 sampled companies, the Dimension Process shows the lowest score (corresponding to the letter H in Table 1). Therefore, it can be considered a potential opportunity for innovation within each company. It was noticed that the Dimension Process corresponds to the reality of the current economic crisis. This dimension is relevant to small businesses in the industry sector, since the decrease in production may be, in many cases, an alternative to reduce operating costs. The limited production may also lead to a climate of employment insecurity, hence, a climate less prone to innovation. Case in point, a printing industry, observed in the sample, lost a customer that demanded 60% of its production. This resulted in highly skilled employees with higher wages being fired? let go. Then, the company lacked skilled labor for certain finishing techniques, which generated additional problems. This snowball effect could have been prevented, if innovative steps were taken before the economic crisis, such as increasing its customer base. Another aspect noted in the crisis was the elimination of external services, such as consulting or training.

#### IV. DISCUSSION AND ANALYSIS OF RESULTS

During the research, it was noted that business owners found it difficult to obtain long-term loans at reasonable interest rates to finance innovation, leading them to pursue innovations out of necessity, and therefore reactively. By

analyzing all the companies in the sample, it was possible to diagnose and define improvement opportunities in their processes:

a) **People Management:** Entrepreneurs mostly showed dissatisfaction with employees in the relationships and cultural aspects of the company. For example, behavior, attendance, delegation of tasks, and commitment to the company's rules were some elements they mentioned;

b) **Financial Management:** The main problems were related to the misuse of cash flows, mismanagement of payable and receivable accounts, lack of planning and financial education;

c) **Marketing Management:** There were deficiencies in grouping customers according to their needs, loyalty, prospecting, distribution, and after-sales;

d) **Organizational Management:** There was insufficient definitions of roles and tasks, role delegation, and identification of employee responsibilities;

e) **Production Planning and Process Control:** In several cases, a lack of tracking or alignment of inventory, production, quality control, shipping, and planning was found.

As the above obstacles were prioritized by the companies' owners, suggestions were made to generate a common groundwork, with the purpose of improving those companies. Then, action plans were developed to resolve management processes.

This premise shows that aligned and consolidated management is the first step to creating a steady, innovative culture in the search of significant results [17].

There were several challenges observed in the companies, such as neglect; lack of monitoring; lack of method or discipline to maintain the organization's processes, warehouses, manufacturing industry, and offices. Moreover, waste should be avoided and analyzed strategically.

Expanding the focus, some factors aggravated the organizational management and restructuring of small firms in the sample, the strongest example of this, being the economic crisis of the country (the strongest example is the economic crisis of the country). According to SEBRAE [18], the main cause of the manufacturing industry's production decline was the reduction of investments, especially in machinery and equipment, seen in both private and governmental companies. Other difficulty identified was to find skilled labor or reach new target markets, which highlights weaknesses in the strategies or investments, limiting the use of productive capacity and generating idleness [19]. Table 2(a and b)

shows the scores reached for each dimension. Companies are identified with the letter "E" at the top of the table; the dimension averages are shown in the far-right column, and the companies' totals are listed in the bottom row of the table:

Table.2 -a: Score obtained from the radar Innovation applied to the sample firms.

Dimension	E 1	E 2	E 3	E 4	E 5	E 6	E 7	E 8	E 9	E 10
Offer	3	4	4	3	3	4	4	4	4	2
Platform	2	1	5	4	4	3	2	1	4	2
Brand	3	3	4	2	3	3	3	2	2	3
Customers	1, 7	1, 3	4, 3	3, 1	2	2, 7	3, 7	2, 3	2, 3	3, 7
Solutions	1	3	5	2	3	3	3	4	2	3
Relationship	2	2	4	4	1	4	5	1	4	4
Value	1	1	2	2	3	3	4	2	2	2
Processes	1	1	1	2	1	2	1	2	2	1
Organization	3, 7	2	3, 1	1, 7	3	4	3, 7	3, 7	2, 3	2
Supply Chain	1, 3	2	2	3, 1	3	2	4	2	1, 7	2
Presence	2	1, 3	3, 1	3	2	4	2	1, 7	2	2, 7
Network	2	1, 7	2, 1	4	2	3	4	2	2	3
Innovative environment	1, 3	2	2	2, 7	2	2, 7	2	2	1, 3	2
Company average	1, 9	1, 9	3, 2	2, 8	2, 5	3, 3	3	2, 5	2, 5	2, 5

As it can be observed, eight companies achieved averages above three. They are considered by the methodology as Occasional Innovative companies. However, most of the other companies reported not having made significant changes in their processes over the past three years. This resulted in low scores for the Dimension Process, receiving a designation of Little or No Innovation. This shows that, from the perspective of those managers, their processes have not received the focus for desirable innovation. Sixty per cent of organizations are, on average, below three, most reached a minimum score in the Dimension Process.

The common factor in the companies was business conduct, treating innovation as something specific and not as a continuous process. From the 20 companies surveyed, seven scored below half, which places them in the category of Little or No Innovation. Finally, the Systemic Innovative companies are the companies with a score of 5 (maximum overall innovation performance). But it is important to note that each company has its own entity and faces a different set of challenges, even when it takes part of the same industrial size.

Table.2 -b: Score obtained from the radar Innovation applied to the sample firms.

Dimension	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
Offer	3	3, 1	5	4	4	4	5	4	4	4
Platform	3	4	2	2	3	2	4	2	4	4
Brand	1	3	4	2	4	3	2	4	4	3
Customers	2	2	3	2	3	3, 7	2	3	3	3
Solutions	4	4	2	2	3	3	4	3	4	4
Relationship	4	4	2	2	3	5	3	4	4	4
Value	2	2	2	2	3	3	3	3	3	2
Processes	2	2	2	2	3	2, 7	2	2, 3	2, 3	3
Organization	4, 2	2	3	2	3	3, 7	3	3	2	3
Supply Chain	4	2	2, 7	1	3	2	2	1	3	4
Presence	2, 3	3	3	3	4	2	2	3	3	2
Network	2	4	2	2	4	4	3	3	4	2
Innovative environment	2	2	2, 3	1	2, 7	2	1, 9	2	3, 3	3, 3
Company average	2, 7	2, 9	2, 7	2, 1	3, 3	3, 1	2, 8	2, 9	3, 4	3, 2

After an individualized diagnosis for each company, action plans were suggested. The action plans demand improvements in management, to build foundations for the development of cultural innovation. It became clear that most companies made innovations in "emergencies", for

instance, innovations arising from insufficient alternatives, aimed at survival in the market. The dimensions that are more developed in the sample companies, with higher scores on the Innovation Radar, are Presence, Offer, Brand, and Relationship.

The most implemented actions to improve processes were attending courses on people management, quality, and finances; consulting and advisory services for cash flow refinement; rebuilding organizational chart; offering marketing workshops; standardizing processes and customer service to reduce waste; optimizing resources and increasing customer satisfaction; implementing loyalty programs; expanding the audience with service to new markets, increasing participation in fairs and conferences; and finally, offering new products, or kits assembled with existing products.

Observing Table 2a and 2b, we can observe that most organizations had a score of 1 in Dimension Process, meaning that, these companies have Little or No Innovation. Experience in the field has shown that entrepreneurs were mostly conservative concerning production, demonstrating hesitation to invest in this dimension. The employees need a period of adjustment for production changes or maturation process. SMEs normally have a lack of capital investment, and therefore, seek to work in other dimensions that may have more short-term returns, such as reducing costs, or focusing on direct sales.

The authors found that although these companies were framed by their revenues as small businesses, their management style proved to be closer to micro-businesses, with weak administrative operations. The entrepreneurs were focused on productive activities or routines and struggled to keep qualified employees. This resulted in, production bottlenecks and insufficient incentives for innovation.

Managers' greatest difficulty was the delegation of manual, routine duties. Often, they chose the manual work over the administrative tasks, leaving the administrative tasks unchecked. It can also be argued that the Dimension Process was not regarded as a priority by employers. In general, entrepreneurs tend to resist change in their businesses, avoiding risks.

Some of the suggested actions to improve the Dimension Process, were the standardization of production processes; development planning; control of production processes; implementation of quality tools [20]; cultivation of partnership with other companies and suppliers to streamline inventories; documentation of inventory for finished products; and management of raw materials and waste, for example, recycling resale waste.

None of the companies analyzed had professionals allocated to develop or implement innovations, particularly in relation to the pressing digital transformation.[21] Furthermore, none of the companies was able to hit a strong overall diagnosis mark. Consequently, companies are not considered innovative in the manufacturing segment. In this case, we can see a major deficiency in the processes of small businesses in the south region of São Paulo.

The ethical aspects of this research are highlighted. In general, this study considered the following ethical issues: (1) voluntary participation; (2) ensuring the anonymity and confidentiality of the data obtained.

Regarding the dissemination of results, it occurs on two fronts: (1) academic-scientific: publication of results in high-impact scientific journals and congresses; (2) feedback of the results to the participants. The results will be delivered via e-mail through an executive summary and the full research report (master's dissertation). In addition, there may also be publications (books, booklets) to be delivered to the SME actors in the sample. The execution of these last actions will depend on the establishment of partnerships for their achievement, for example, with the Special Secretariat for Micro and Small Enterprises (SEMPE). This is responsible for formulating policies aimed at SMEs, an instance established by Complementary Law No. 155/2018 to manage the differentiated and favored treatment of this segment, provided for in articles 170 and 179 of the Federal Constitution, as well as the Brazilian Service Support to Micro and Small Enterprises (Sebrae) and other federal public administration bodies.

## V. CONCLUSION

The main component of this article is to identify opportunities for improvement and innovation in Dimensional Processes in the companies interviewed. Note that small businesses have a lot in common, for example, most started as micro or family and, after their growth, had a financial gain, as well as an increase in the number of employees, etc.

The lack of strategic planning and strong management practices, aligned with the company's values, a context that was addressed in the analysis of the results, can be considered an important limiting factor of the innovation potential in small companies. A culture of innovation as an ongoing process depends on robust management, strategy and qualified and motivated employees, to enhance innovation as a way to stimulate the development of the organization as well as to increase its chances of survival in the market.

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# Sustainable Finance: A Bibliometric Study of Real Options as a Financial Tool for Making Geothermal Renewable Energy Feasible

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**Keywords—** Investments, real option,  
geothermal, renewable energy, sustainable  
finance.

**Abstract—** The finance, investment, and renewable energy (RE) sectors are fundamental to any climate change program and the relationship among them has been a topic of growing interest. Financial assessments have hampered geothermal energy development and a real options approach could contribute to making it more feasible. This article aims to expand the understanding of investments and real options in geothermal power plants, selecting relevant studies on the subject and performing their bibliometric analysis.

The real options theory is known for increasing the value of projects under uncertainty by modelling their flexibility in response to changes in their environment. It could be used to address environmental issues in the context of geothermal energy, which is a source of continuous low-carbon energy and heat.

A structured process was used for the selection and analysis of the studies. The Pro Know-C literature was searched on the Scopus and WoS databases, with investment analysis and renewable energy as core topics. The articles found were systematically sorted, resulting in a bibliographic portfolio (BP) of 25 articles, which supported the bibliometric analyses. The highlights of the bibliometric analyses are: a) journals - Energy Policy, Energy Economics, and Renewable and Sustainable Energy Reviews; b) authors - Ferreira, P. participated in 3 studies in the selected BP and Fleten, S. E. participated in more than 10 studies listed in the BP references; and c) articles - (Boomsma et al., 2012) and (Fernandes et al., 2011) led the ranking of academic relevance.

## I. INTRODUCTION

The recent changes in the global climate are unprecedented. Different regions of the world are already being affected by extreme events such as heat waves, heavy rains, droughts, and cyclones caused by global warming. These are the findings of the AR6 report, approved and released by the Intergovernmental Panel on Climate Change (IPCC), released in August, 2021. This report is the first to claim with 100 percent certainty that human activities have caused climate change. In 2019, the

concentration of carbon dioxide (CO<sub>2</sub>) in the atmosphere was higher than at any other time in the last 2 million years and the concentration of methane and nitrous oxide was the highest in 800,000 years. However, a significant reduction in the emission of greenhouse gases (GHG) can still limit climate change (Masson-Delmotte et al., 2021).

The finance/investment and renewable energy (RE) sectors are central to any climate change program. Although the finance/investment sector have been slowly responding to the new demands of sustainable

economy(Ryszawska, 2016),these are considered fundamental for the progress of the energy carbon-zero transition, acting as a facilitator and catalyst for the transformation of economic climate(Chenet et al., 2019). The renewable energy sector, in turn, is the main component of any climate change mitigation strategy(Arent et al., 2011) and its associated technologies have garnered increasing interest as it has become a reality in recent years.(Dranka et al., 2020).

Despite the increased RE generation worldwide(Arent et al., 2011), geothermal renewable energy generation using thermal energy from the earth's interior, with low carbon production and continuous supply capacity, has not gained the required scale.It still fails to meet the targets established for this source, because of financing and the apparent limitation of the traditional calculations of net present value (NPV) (Lukawski et al., 2016).

Other obstacles, such as high and uncertain capital investment costs, contribute to geothermal remaining marginalised. However, valuations using real options could contribute to its progress. These valuations have proven to yield better results than limited traditional techniques, differing significantly from a standard NPV calculation and offering much deeper insights into the risks associated with the development of geothermal source(Compernelle et al., 2019; Fernandes et al., 2011).The real options method has proven to be effective in energy investments because of its more realistic estimation of the value of projects. It allows investors to add value, using flexibility to deal with unpredictable fluctuations and provides greater precision in the calculation of subsidies. Additionally, it allows the use of certificates, which are vital for the sustainable development and viability of RE(Liu & Ronn, 2020).

Long-term investments involve relevant uncertainties, which determine the behaviour of investors and the market. Therefore, it is difficult to determine the influence of sustainable elements in this long-term market (Ferreira et al., 2016). ER projects are often high-risk projects. Thus, investors require more sophisticated valuation techniques to assess their investments(Dranka et al., 2020).

This issue emphasizes the need to develop requisite knowledge in a systematic way, based on scientifically recognised sources, to address the question: How could the real options approach contribute to the analysis of investments in geothermal power plants?

Thus, this article aims to expand the understanding of investments and real options in geothermal power plants, especially by:

- i. Selecting references on investment analysis and real options in geothermal power plants; and
- ii. Performing bibliometric analysis of articles, their references, prominent authors and journals on this topic.

The Knowledge Development Process–Constructivist (ProKnowC) tool was used to achieve these goals. It is a structured process with a constructivist perspective for the selection and analysis of scientific literature. It takes into consideration the researcher's purpose when studying a given topic, and allows the generation of the necessary framework for scientific research.(Lacerda, 2021; Lacerda et al., 2012).

The development of this knowledge by the researcher is represented here by the selection of relevant articles for the bibliographic portfolio and bibliometric analysis of investments and real options in geothermal power plants.

Bibliometric analysis, which was popularised by Pritchard in 1969, consists of a set of methods and techniques for visualising information and drawing up maps that can adequately represent the quantitative and cognitive aspects of science(Macedo dos Santos & Kobashi, 2009; Vanti, 2002). The parameters considered for this research are: the selected articles, their references, authors, number of citations, and most relevant journals.

The rest of this article is structured as follows. Section 2 discusses the theoretical framework, Section 3 presents the methodological framework and procedures used in this research, Section 4 describes the bibliometric analyses and results; Section 5 presents the conclusions and notes, and finally, the last section lists the references used in this article.

## II. THEORETICAL FRAMEWORK

RE financing and sustainable finance: RE financing promotes the sustainable financial system by aligning with the long-term needs of a sustainable economy. It includes the following aspects: climate finance, aiming to reduce GHG; green finance, by seeking regenerative environmental outcomes; and sustainable finance, by improving environmental, social, and economic outcomes(Ryszawska, 2016).Sustainable finance uses more robust metrics to seek models in which all relevant costs and benefits are properly accounted for, including the explicit recognition of incremental cash flows attributable to sustainability, in addition to the usual set of cash flows(Popescu et al., 2021).

The economic evaluation of investments in energy: Investments in energy have specific characteristics that differentiate them from others, such as practically irreversible investment once the capital becomes immobilised, preventing it from being used for other areas or companies. There also exists a temporal flexibility which allows the investor to postpone the decision to select the best investment moment. Furthermore, several generation technologies associated with different levels of uncertainty can be chosen. Therefore, it is mandatory for investors to have adequate tools for investment analysis, which accounts for this matrix of risks and uncertainties(Santos et al., 2014).

Real options: The real options theory is known to increase the value of projects under uncertainty. This is achieved by modelling the flexibility of managers to adjust projects in response to changes in their environment. This theory could be used to address current energy and environmental issues, increasing the value of electricity generation projects, especially renewable energy projects(Martínez Ceseña et al., 2013).

Geothermal energy: Geothermal energy is a renewable energy source that is derived from thermal energy generated and stored inside the earth. Its production

has a low carbon footprint and can provide continuous energy and heat. However, despite its environmental and economic benefits and in contrast to most renewable energies, the development of geothermal energy has not achieved the expected growth. High initial investment and multiple sources of uncertainty result in high investment risk, making it difficult to raise the necessary capital(Compennolle et al., 2019).

### III. METHODOLOGY

There is no one size fits all approach to conduct research. The methodological choices influence the findings, and the most appropriate approaches, strategies, and methods for research depend on the problem being addressed(Calvetti, 2019; SAUNDERS, 2009). Hence this section aims to provide the reader with sufficient information to understand the reliability and validity of the methods used in this research.

#### 3.1 Methodological framework

The methods, techniques, and procedures selected for this research are show in Figure 1.

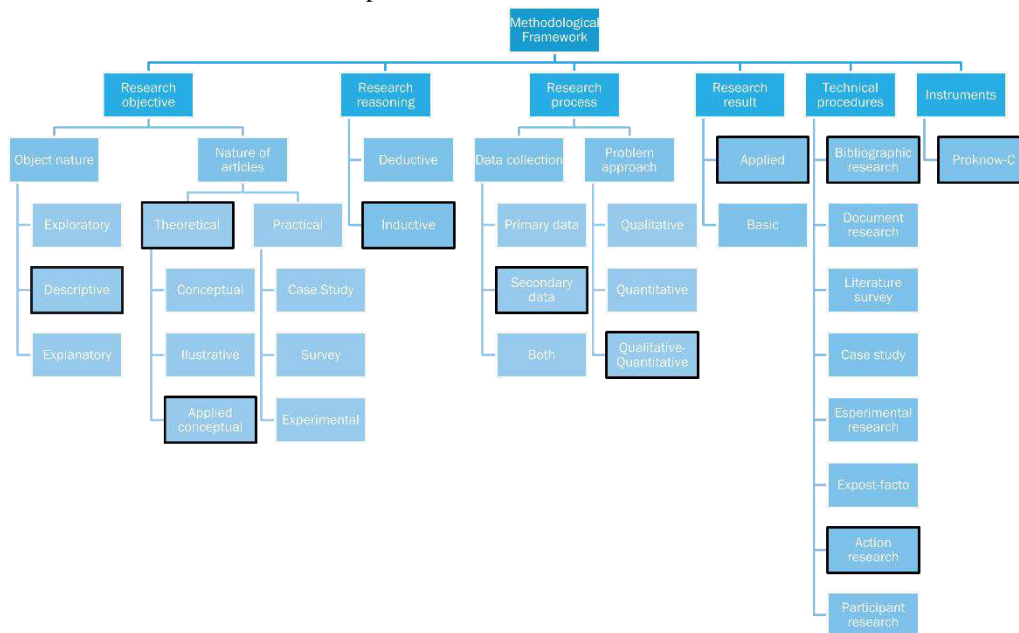


Fig.1 - Methodological framework

Source: Adapted from (Lacerda et al., 2012)

#### 3.2 Intervention instrument

According to Saunders (2009), literature review is an initial step in providing the foundation upon which research is developed, with the main objectives of augmenting the understanding and gaining insight into past research and trends. It helps to review the most relevant and significant research on the topic of interest. An effective

analysis allows to get familiar with the current state of knowledge on a given subject and the respective limitations of studies(SAUNDERS, 2009).

Thus, to establish a representative sample of references on the topic, we used the Knowledge Development Process-Constructivist Pro Know-C structured process as an intervention instrument for the



selection and analysis of scientific literature. It was developed in the Multicriteria Methodology Laboratory of Decision Support (LabMCDA) of the Federal University of Santa Catarina (UFSC)(Ensslin et al., 2017).

The steps of Pro Know-C addressed here include bibliographic portfolio selection and bibliometric analysis. The procedure carried out in each of the stages of the investigation is described below in detail.

**3.3 Initial search for portfolio selection**

The initial search consisted of the selection of articles that will form an initial, non-filtered database, which is later filtered to include articles considered to be of greater significance for the research topic.

The procedures described in this study were carried out in June 2021 and articles published in the databases in the last 10 years (2011 to 2021) were considered.

Two scientific databases, Scopus and Web of Science, were selected for the study. These databases are considered relevant in the international scientific community and offer more search options and advanced filters using Boolean expressions. Therefore, the authors believe that the selected databases are suitable for the purpose of this research.

Two core topics were combined, investment analysis and renewable energy, and the keywords to be searched in the selected databases were defined. Different words were combined using search strings. The number of articles found in each database can be seen in Figure 2.

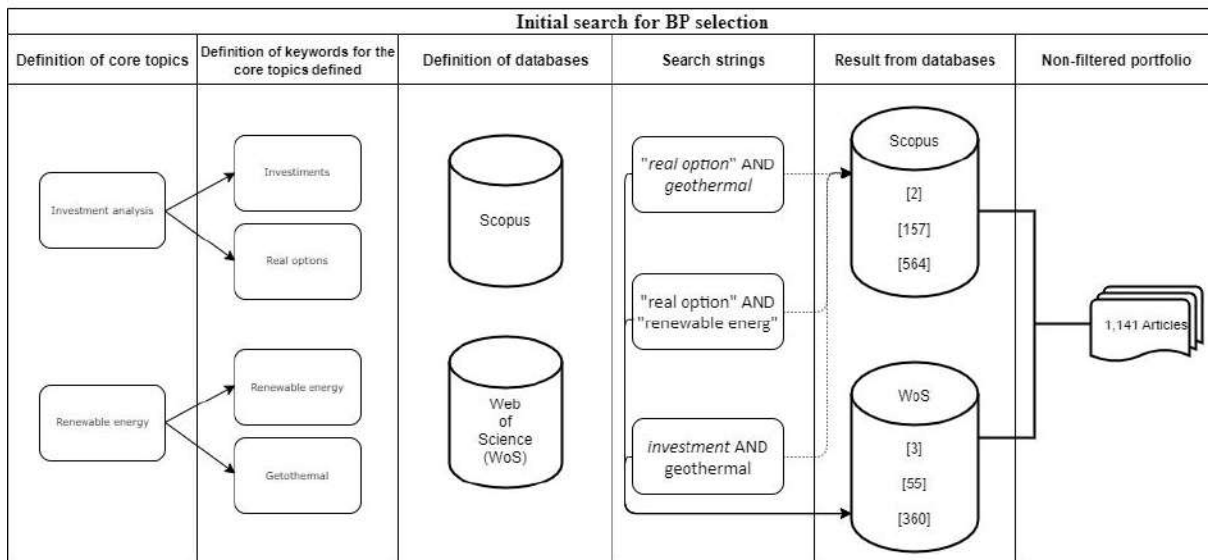


Fig.2 - Initial search for BP selection

Resultantly, 1,141 articles were obtained, which are now part of the Non-filtered Article Database.

**3.4 Choice of articles to compose the bibliographic portfolio**

The next step of the ProKnow-C process was taken using the EndNote20 software and consisted of identifying and excluding duplicate articles, resulting in the exclusion

of 250 references. The remaining 891 articles were filtered using their titles and excluding those that were not aligned with the initially defined core topics, resulting in 119 articles.

The process of filtering articles from the non-filtered bibliographic portfolio is illustrated in Fig.3.

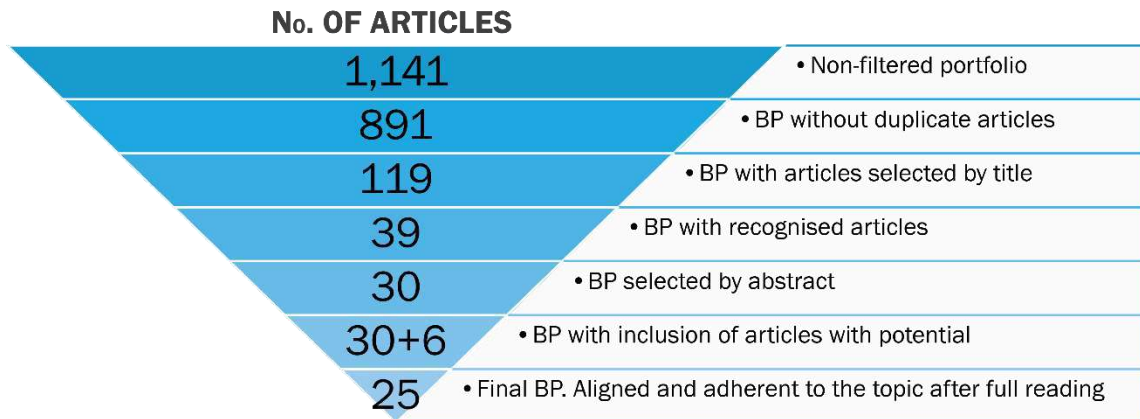


Fig.3 - Filtering Steps

The next step included the analysis of the scientific recognition of these 119 articles, based on the number of citations of each one, using the Google Scholar online tool (Google, 2021) and the ZOTERO software. These articles were classified in descending order, allowing the identification of the most relevant ones.

The authors of the present study used a cut-off value of 82% articles with more citations, which correspond to 39 articles, totalling 2,909 citations, as can be seen in Fig.3. The 80 unselected articles, with scientific recognition not yet confirmed, in line with Pro Know-C, will undergo further analysis and evaluation.

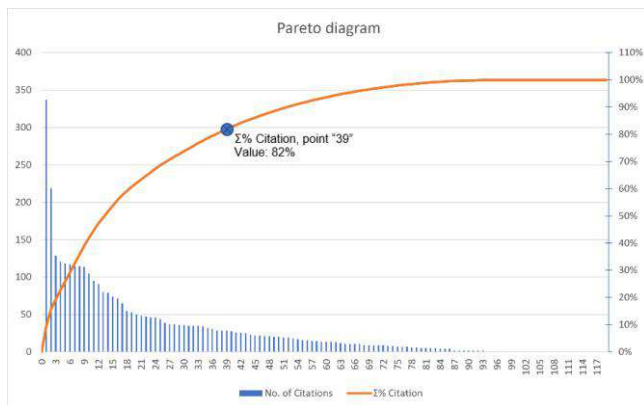


Fig.4 - Selection of Articles by Scientific Recognition

The 39 selected articles were analysed in respect of their alignment with the current research objective. After

reading the respective abstracts, 9 articles were excluded at this stage, leading to 30 articles.

In the next step, 80 articles with potential for scientific recognition and pending confirmation were retrieved, representing 18% of citations. Of these, the abstracts of articles published in the last two years (after 2019) were read to check alignment with the research topic as they had little chance of having even a low number of citations. Authors of articles published before 2019 were searched in the database of authors who wrote the articles selected in the preceding step. If they were not in the list, they were excluded. Otherwise, the abstract was read to confirm adherence. At this stage, 6 articles were selected.

All 36 selected articles were fully read to identify the alignment to research and adherence to the proposed theme. A total of 11 documents were eliminated at this stage, resulting in a bibliographic portfolio consisting of 25 articles, which formed the BP of this research. From this BP, bibliometric analyses were carried out to support the results and description of this report.

#### IV. RESULTS

A BP was formed consisting of 25 articles, which are arranged in descending order as per number of citations as shown in Fig.7.

Sequence	Authors	Title	Year	No. of citations
1	T. K. Boomsma, N. Meade and S. E. Fleten	Renewable energy investments under different support schemes: A real options approach	2012	337
2	B. Fernandes, J. Cunha and P. Ferreira	The use of real options approach in energy sector investments	2011	219
3	E. A. Martínez-Ceseña, J. Mutale and F. Rivas-Dávalos	Real options theory applied to electricity generation projects: A review	2013	121
4	S. Fuss, J. Szolgayová, N. Khabarov and M. Obersteiner	Renewables and climate change mitigation: Irreversible energy investment under uncertainty and portfolio effects	2012	118
5	E. A. Martínez-Ceseña and J. Mutale	Application of an advanced real options approach for renewable energy generation projects planning	2011	115
6	L. Santos, I. Soares, C. Mendes and P. Ferreira	Real Options versus Traditional Methods to assess Renewable Energy Projects	2014	115
7	K. Kim, H. Park and H. Kim	Real options analysis for renewable energy investment decisions in developing countries	2017	114
8	I. Ritzenhofen and S. Spinler	Optimal design of feed-in-tariffs to stimulate renewable energy investments under regulatory uncertainty - A real options analysis	2016	105
9	S. Bruno, S. Ahmed, A. Shapiro and A. Street	Risk neutral and risk averse approaches to multistage renewable investment planning under uncertainty	2016	80
10	J. A. Schachter and P. Mancarella	A critical review of Real Options thinking for valuing investment flexibility in Smart Grids and low carbon energy systems	2016	74
11	N. Detert and K. Kotani	Real options approach to renewable energy investments in Mongolia	2013	72
12	P. K. Wesseh, Jr. and B. Lin	Renewable energy technologies as beacon of cleaner production: A real options valuation analysis for Liberia	2015	65
13	M. Kozlova	Real option valuation in renewable energy literature: Research focus, trends and design	2017	55
14	T. K. Boomsma and K. Linnerud	Market and policy risk under different renewable electricity support schemes	2015	53
15	M. Z. Lukawski, R. L. Silverman and J. W. Tester	Uncertainty analysis of geothermal well drilling and completion costs	2016	48
16	S. E. Fleten, K. Linnerud, P. Molnár and M. Tandberg Nygaard	Green electricity investment timing in practice: Real options or net present value?	2016	47
17	M. M. Zhang, D. Q. Zhou, P. Zhou and H. T. Chen	Optimal design of subsidy to stimulate renewable energy investments: The case of China	2017	46
18	H. X. Li, D. J. Edwards, M. R. Hosseini and G. P. Costin	A review on renewable energy transition in Australia: An updated depiction	2020	44
19	C. Y. Chang	A critical analysis of recent advances in the techniques for the evaluation of renewable energy projects	2013	39
20	M. Cárdenas Rodríguez, I. Hašćić, N. Johnstone, J. Silva and A. Ferej	Renewable Energy Policies and Private Sector Investment: Evidence from Financial Microdata	2015	37
21	M. M. Zhang, Q. Wang, D. Zhou and H. Ding	Evaluating uncertain investment decisions in low-carbon transition toward renewable energy	2019	26
22	A. C. Passos, A. Street and L. A. Barroso	A Dynamic Real Option-Based Investment Model for Renewable Energy Portfolios	2017	15
23	G. G. Dranka, J. Cunha, J. D. de Lima and P. Ferreira	Economic evaluation methodologies for renewable energy projects	2020	9
24	T. Compennolle, K. Welkenhuysen, E. Petitclerc, D. Maes and K. Plessens	The impact of policy measures on profitability and risk in geothermal energy investments	2019	9
25	X. Liu and E. I. Ronn	Using the binomial model for the valuation of real options in computing optimal subsidies for Chinese renewable energy investments	2020	8

Fig.5 -BP Table of Articles

### 5.1 Bibliometric analysis of BP

Bibliometrics is a quantitative and statistical technique to measure indices of knowledge production and dissemination. It helps to monitor the development of various scientific areas and patterns of authorship, publication, and use of research results (Costa, 2012). This section presents the bibliometric analyses and studies conducted on the BP.

#### i. Articles

We analysed the scientific recognition of articles within the BP, identified by the highest number of citations

in Google Scholar as on June 2020 shown in column 'Number of citations' in Fig.7. We observed that the articles by (Boomsma et al., 2012) and (Fernandes et al., 2011) are the most predominant, with 337 and 219 citations, respectively, corresponding to 28% of the total citations.

#### ii. Authors

The authors of the articles composing the selected theoretical framework, who participated in more than one article in the sample, are shown in Fig.7

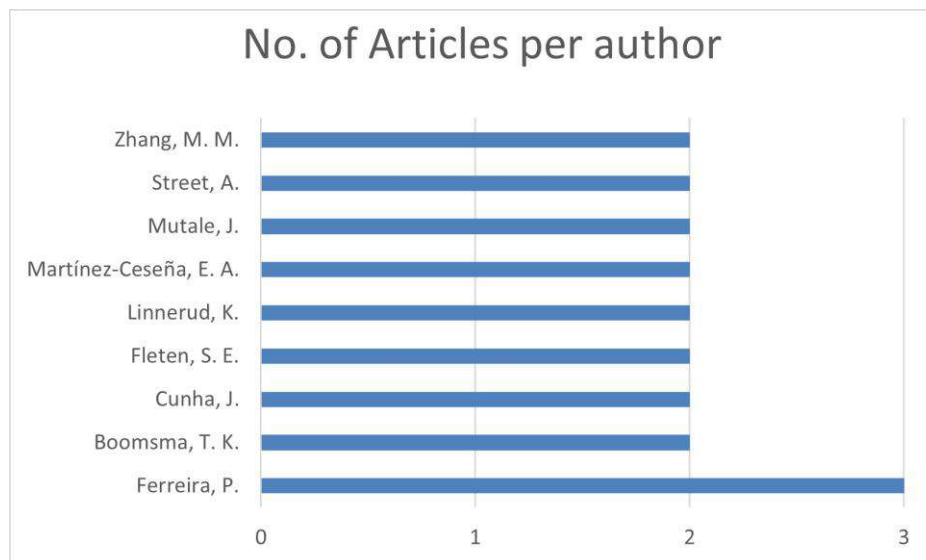


Fig.6 - Main Authors of BP

iii. Journals

Six journals had more than one publication in BP and are presented in Fig.7. The journal Renewable and

Sustainable Energy Reviews is the most prominent, with seven published articles (28%), more than double the number of other publications.

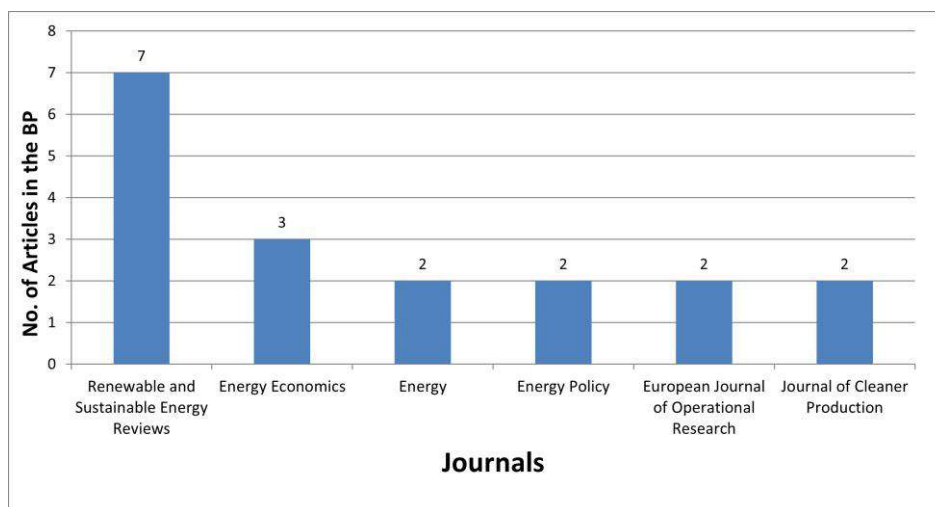


Fig.7–Most prominent Journals of the BP

iv. Keywords

The most prominent keywords were analysed using a network of co-occurrences of the articles of the BP. VOS viewer software was used for analysing the sections of

the title, abstract, and the list of keywords of the documents. Fig.8 demonstrates the frequency of occurrences of the keywords by the size of the circle. The strength of association is represented by the proximity between them.

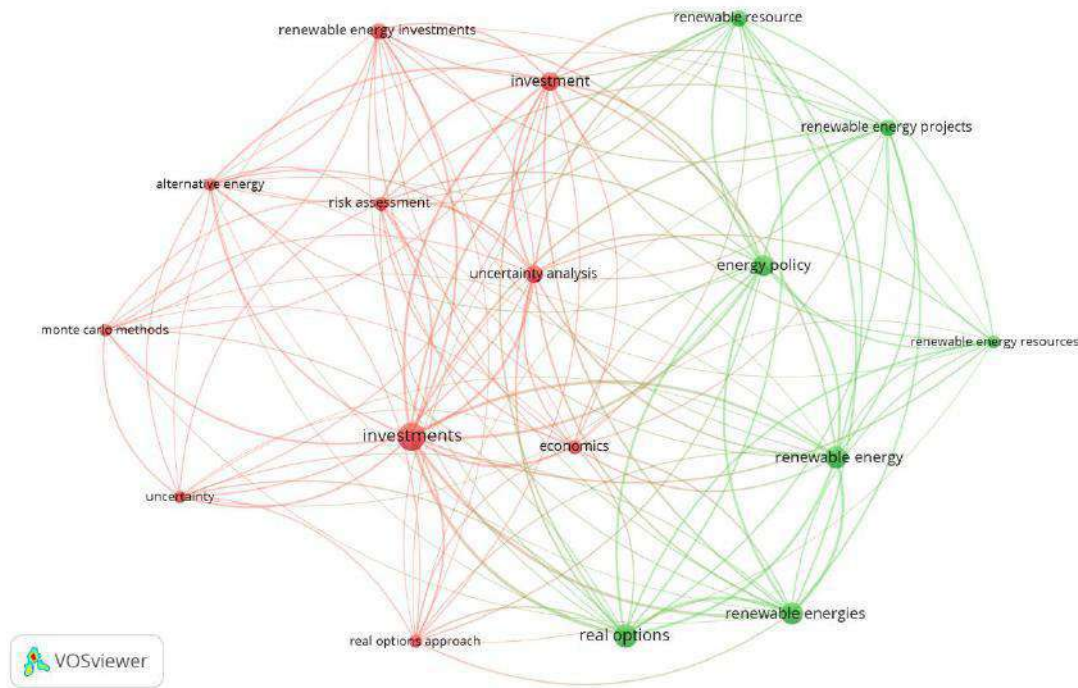


Fig.8– Keywords of the BP

**5.2 Bibliometric analysis of the references of the BP**

To further identify prominent authors, articles, and journals in the research context, the 703 articles listed in the references of the BP were analysed. The results are described below.

- i. Most prominent authors

The most prominent author in the BP is Fleten S.E., who has published ten articles. Figure 9 shows the relative position of this author compared to other authors with more than five publications in the references of the BP.

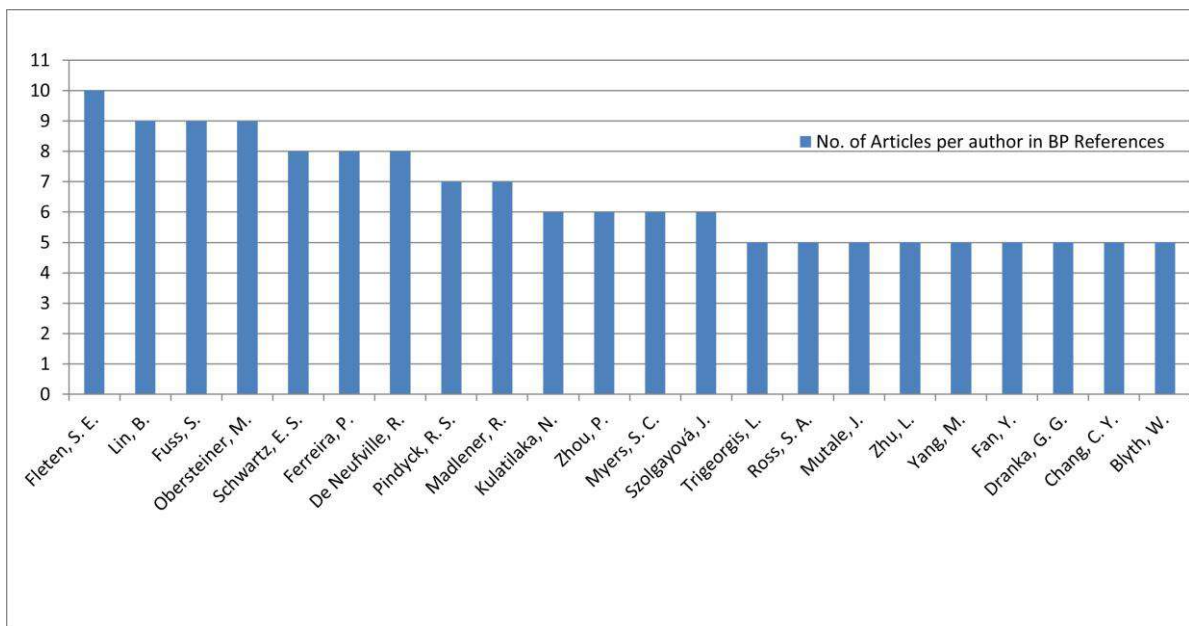


Fig.9 – Main Authors in BP References

ii. Journals

The journals that published more than 10 articles listed in the references of the BP are presented in Fig.10.

The most prominent are Energy Policy, with the publication of 71 articles, representing more than double the mean publication among the most prominent journals.

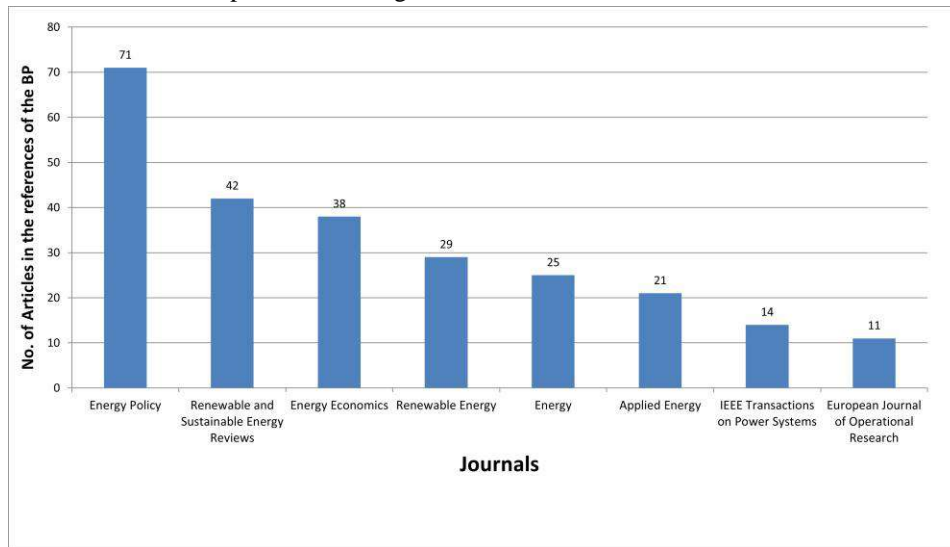


Fig.10 – Main Journals in the BP References

5.3 Bibliometric analysis, BP versus references of the BP

i. Journals

Journals that published more than six articles which are listed in the references of the BP were compared

with journals of the BP, as illustrated in Fig.11. The most prominent journals such as Energy Policy, Energy Economics, and Renewable and Sustainable Energy Reviews, were positioned in quadrant A, standing out both in BP and their references.

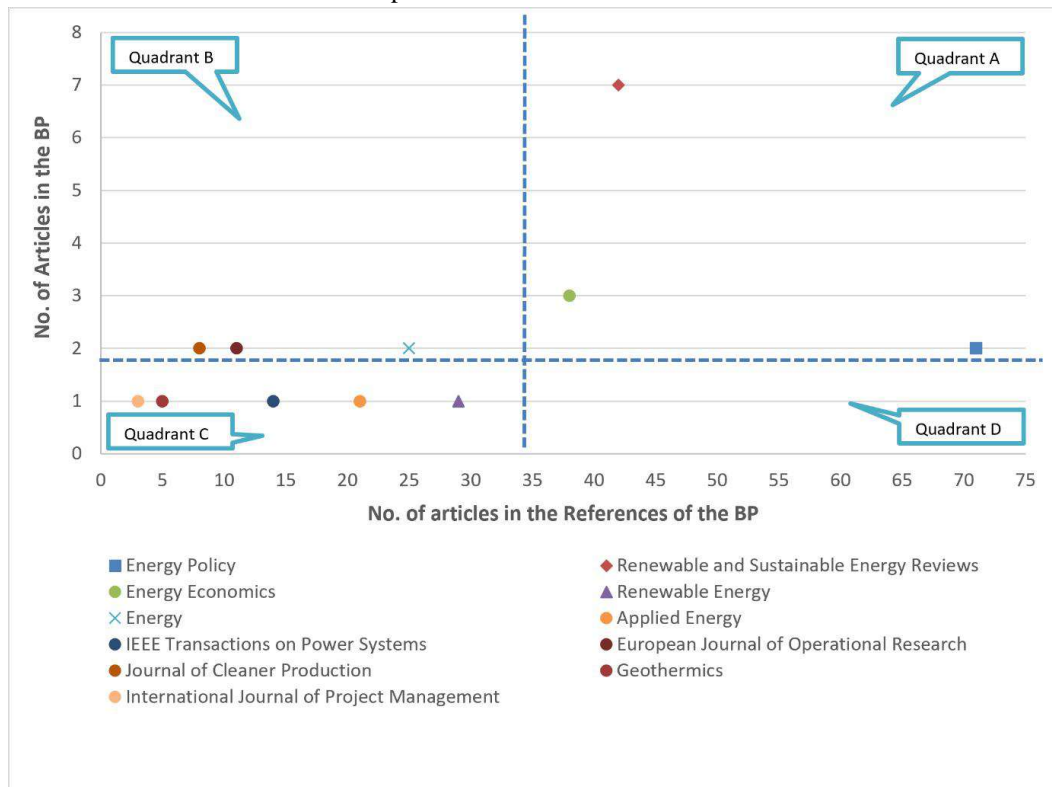


Fig.11 – Prominent Journals of the BP and References of the BP

ii. Classification of articles according to academic relevance in the sample

Two criteria were considered when classifying the articles of the BP by their academic relevance: 1) number of citations in Google Scholar (2021) since the publication of the article; 2) number of citations of the author with greater citations in the references of the articles in the portfolio, according to Fig.12.

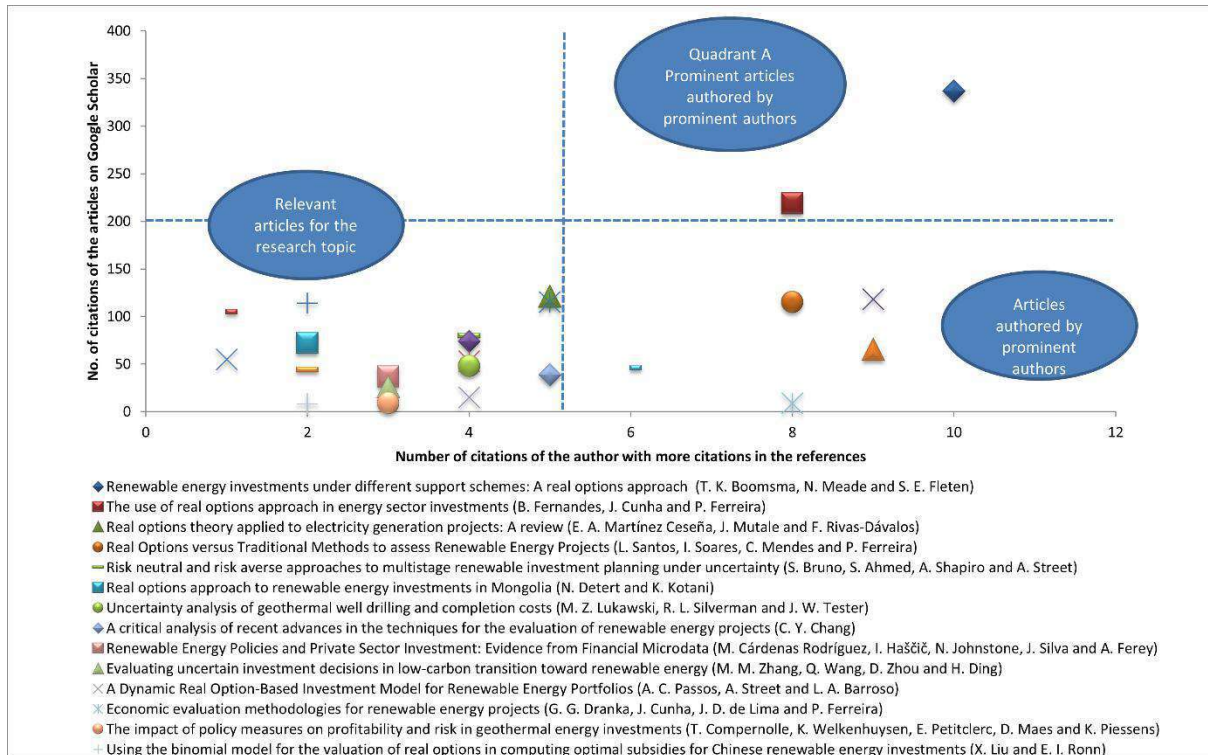


Fig.12 - Classification of Articles According to their Academic Relevance.

A horizontal and a vertical line were drawn dividing the image in four quadrants, which accommodates the combinations between the number of citations of the article and the number of citations of the author with higher citations in the references. Quadrant A accommodates articles with a great potential to contribute to the research topic, consisting of prominent articles written by prominent authors, namely, (Boomsma et al., 2012) and (Fernandes et al., 2011).

V. CONCLUSION

Given the imminent need to create mechanisms to mitigate global warming, it becomes crucial to conduct academic research for improving financial tools and the viability of renewable energy projects.

Therefore, this study proposed a relevant theoretical BP, detailing the systematic process used (Proknow-c), which started with the evaluation of 1,141 articles and resulted in a portfolio of 25 articles, as can be seen in Fig.7

The bibliometric analyses performed based on the BP and the references in the BP revealed that: a) the most prominent journals are Energy Policy, Energy Economics, and Renewable and Sustainable Energy Reviews; b) the author, Ferreira, P., is the only one who participated in three studies in the selected BP while Fleten S. E. has more than ten studies in the BP; and c) the articles (Boomsma et al., 2012) and (Fernandes et al., 2011) are the most academically relevant articles in terms of number of citations and authors with greater citations in the references of the articles selected in the final portfolio.

Our analysis of the scientific production on investments and real options in geothermal plants provides insights for the better understanding of the topic by the scientific, business, and social communities. It can contribute towards the planning and optimisation of future research. Future studies could perform a systemic content analysis of the selected portfolio for identifying research opportunities.

A limitation of this study is that it only considered articles indexed in the Scopus and Web of Science databases between 2011 and 2021.

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## Wind Complexes Environmental Licensing in Bahia backwoods ridges, Brazilian Semiarid

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**Keywords**—Wind energy; Renewable energy;  
Social and Environmental Impacts;  
Territorial Development; Environmental  
Licensing

**Abstract**— Bahia's backwoods ridges belong to a mountain range called "Serra do Espinhaço" which historically are explored by regular or clandestine mining companies. Since the beginning of 2010's decade, the abundance of wind has attracted companies interested in the use of it for energy generation. Nevertheless, these ridges also are part of recharging zones that supplies important water reservoirs in Brazilian's semiarid and Caatinga's region. The ridges riches awoke interest in some companies who insist to explore in a predatory way, and take advantages of State's regulatory flexibility, violating stability, and compromising essential ecosystem services in Brazilian semiarid region. The use of renewable energies is not free from environmental impacts. Scientists and social organizations denounce serious problems related to the licenses and operations of the wind enterprises, who, by the way, have been investigated by Bahia's Public Prosecutor's Office. It is important to evaluate and describe the consequences of implementing these wind farms, whose defects threaten local communities. This research is based on the Environmental Information System of Bahia's State and intends to analyze qualitative and quantitatively and describe some failures identified in environmental licensing processes for wind projects. This study also aims to analyse the modus operandi of the energy sector companies related to the communities that live together with this kind of undertaking in a region known as an important center of biodiversity and endemism. The researched region contributes to the water supply of about one million people in the Brazilian semiarid region.

### I. INTRODUCTION

The use of wind to produce energy is an expanding enterprise in Brazil. According to ANEEL (2021), by 2024, the wind power capacity installed in the country will be

increased from 19 to 30 GW. Nowadays, the wind energy corresponds to 10% of the energy shared with National Interconnected System (Sistema Interligado Nacional - SIN), according to Brazilian Association of Wind Energy (ABEEólica, November 2021), making the wind energy the

second source of the Brazilian electricity matrix, exceeding the amount of energy generated by thermoelectrics (ABEEólica, 2021a).

According to Camargo-Schubert EngenheirosAssociados (2013), Bahia's wind potential estimated capacity is 70 GW, which is considered a potential of great magnitude. This magnitude corresponds to 13 times its current capacity and results in an energy production estimated at 273 TWh/year.

Bahia is the second largest Brazilian state that generates wind energy (Table 1). It also is one of the states with highest potential (ABEEólica, November 2021).

Table 1. Installed capacity, number of wind farms and wind turbines by state.

State	Power (MW)	Number of wind	Wind turbines
RN	5.575	191	2.444
BA	5.267	201	2.261
CE	2.385	92	1.115
PI	2.355	81	1.007
RS	1.836	80	830
PE	798	34	417
MA	426	15	172
SC	239	14	173
PB	157	15	121
SE	35	1	23
RJ	28	1	17
PR	3	1	5
<b>Total</b>	<b>19.103,4</b>	<b>726</b>	<b>8.585</b>

Source: ABEEólica (June/2021).

Attractive to investors, the abundance of bahian winds exposes local populations to actions of energy conglomerates that act behind the scenes of global mobilization for renewable energies. These conglomerates advance devastatingly in the territories where they settle bases, bringing negative consequences in the social, economic, and environmental dimensions.

On the other hand, it is observed, both in Bahia and in other Brazilian states (Araújo et al., 2020; Brannstrom et al., 2017; Gorayeb et al., 2016, 2019; Meireles, 2011), that the environmental licensing agencies, who are responsible for protecting environmental, act permissively and flexibly, offering companies in the sector a free territory to act illegally.

The purpose of this paper is to point out some gaps found on the environmental licensing in Bahia, Brazil, based on the analysis of public documents referring to wind projects in activity in Bahia's backwoods ridges, Brazilian semiarid.

## II. METHODOLOGY

This study was based on a qualitative and quantitative analysis. It also is documental research carried out by official documents available on government platforms of the state of Bahia, Brazil. The platform that was used was the Environmental Information and Water Resources System of Bahia (Sistema Estadual de Informações Ambientais e de Recursos Hídricos do estado da Bahia - SEIA). By consulting this platform, it was possible to recover files that instructs environmental licensing processes for wind enterprises. In addition, official documents made available by the Public Prosecutor's Office of the State of Bahia were also consulted.

Georeferenced data provided by the National Electric Energy Agency (ANEEL, 2021), organization that regulates the Brazilian electricity system, were also consulted.

## III. RESULTS AND DISCUSSION

Wind speed is one of the determining elements to ensure the economic viability of a wind farms, and speeds from 5.5 m/s are considered viable. The Fig. 1 presents the annual potential of wind energy in Bahia. The yellow colour represents speeds of 6.5 m/s, while the red and purple colours represent even higher speeds.

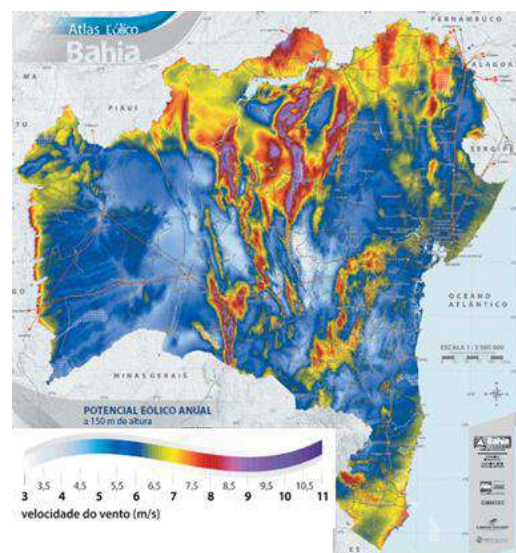


Fig. 1. Annual wind potential of the state of Bahia (at 150 meters height). Source: (Camargo-Schubert Engenheiros Associados, 2013).

The analysis of the documents available on SEIA platform and those available in the Civil Investigations initiated by

the Public Prosecutor's Office of Bahia indicated that exceptionally large wind farms (some of them with more than a thousand wind turbines) are being fragmented into smaller (micro-sized) projects.

Brazilian legislation determinates that quantitative and qualitative factors guide the type of environmental license, consequently, the depth of the studies required to instruct the licensing process.

In accordance with the Resolution of the State Council of the Environment n°. 4.180 April 29, 2011(CEPRAM, 2011), that talks about the environmental licensing process of electric power generation enterprises, by the aeolian source in Bahia and approves the technical standard that guides the implementation of this type of enterprise, the size of wind farms, defined by the number of wind turbines, is the criterion that determinates the depth to be required in the context of studies that support the environmental licensing process.

Table 2 offers the parameters of the Resolution CEPRAM 4.180/2011, as well as the correlation between the size of the wind farm and the type of environmental license required.

*Table. 2: Size of wind farms and type of environmental license.*

Size of wind farms	Number of wind turbines	Type of environmental license
Micro	< 15	L.S.
Small	≥15 > 30	
Medium	≥30 a 60	L.L.; L.I.; L.O.; L.A.
Large	≥ 60 a 120	
Exceptional	≥120	

Source: Resolução CEPRAM 4.180 de 29 de abril de 2011 (CEPRAM, 2011).

The consequence of the fragmentation of exceptional and large undertakings into smaller undertakings is the use of simplified procedures, such as superficial studies and small sampling effort without the participation of civil society, in situations where the current legislation determines conducting Environmental Impact Study followed by the Environmental Impact Report (EIA/RIMA) and Public Hearings.

According to the Resolution CEPRAM/2011, the enterprises with more than 30 wind turbines must pass through environmental licensing process that is carried out in three, or up to four, stages: Location License (Licença de Localização - L.L.), Implementation License (Licença de

Implantação - L.I.), Operation License (Licença de Operação - L.O.) and, when applicable, Expansion License (Licença de Ampliação - L.A.). The greater rigor attributed to wind farms of this size, implies in the obligation of EIA/RIMA. In this case, the legislation also determinates the realization of a public hearing, providing opportunities for civil society participation.

Only simplified studies that are systematised in a document called Simplified Environmental Report (Relatório Ambiental Simplificado - RAS). are required for smaller wind farms (with less than 30 wind turbines). The approval of the RAS guarantees that the enterprise obtains, in a single step, the Simplified License (Licença Simplificada - L.S.) for its implementation and operation.

An emblematic example that illustrates this type of conduct is being implemented in Tombador ridge. This ridge crosses some cities in Bahia: Miguel Calmon, Várzea Nova, Jacobina and Mirangaba. The wind farm, namesake of the ridge range, is responsibility of the company Casa dos Ventos Energias Renováveis S.A. and counts on the implementation of 1.069 wind turbines in two phases: one with 157 wind turbines and the other with 912. The Energy Project has an installed capacity of about 1.864 MW.

The Tombador Ridge Wind Complex is divided into several companies, each attributed to a single wind farm, according to Barrero et al. (2021). Smaller companies receive minor responsibilities that should be assigned to the larger enterprise. In other words, the documents analysed indicate that the company has been using strategies to force the classification of projects of exceptional size in micro enterprises, linked to smaller and unknown companies.

However, the State Decree 14.024, June 6, 2012 (Bahia, 2012) prevents the fragmentation of larger enterprises, because it is not allowed

*the division of enterprises or activities for the purpose of classifying them into smaller classes, and the competent environmental agency must adopt measures to curb such initiatives.* (Bahia, 2012)

There is no way for an environmental licensing agency to assume that so many wind farms deployed individually and contiguously would correspond to an individual wind farm. If the attempt to break up exceptionally large enterprises went unnoticed by the agency, there would still be another legal instrument that should be activated to prevent such deviation from being committed: The Resolution CONAMA 462 from 2014 (CONAMA, 2014). This resolution says that in case of “separate licensing of parks within the same complex” it is necessary to “assess the cumulative and synergistic impacts” even in the case of different wind farms.

The National Council for the Environment (CONAMA), in an exclusive Resolution, the Resolution CONAMA 462 from 2014, to instruct the environmental licensing of wind farms, says that:

*it will be up to the licensing agency to classify the environmental impact of wind power generation projects, considering the size, location and low polluting potential of the activity (BRAZIL, 2014).*

Beside the quantitative aspect, related to the size of the undertaking, it was also analysed qualitative aspects, related, for example to where the wind projects are being implemented after the environmental licensing process. It has been observed that many projects are being implemented in priority areas for Caatinga's conservation defined by the Environmental Ministry Ordinance 463 of 18 December 2018.

An example that can be mentioned is Delfina Wind Farm, owned by Enel Green Power Delfina Eólica S.A. This wind farm has 114 wind turbines in operation. It is located in Campo Formoso and it is currently operating in an area that belongs to an category of extremely high biological importance, according to the mentioned Ordinance MMA 463/2018 (Brazil, 2018).

The mentioned example is not an isolated fact, other companies have been obtaining environmental licenses from Environment and Water Resources Institute (Instituto do Meio Ambiente e dos Recursos Hídricos – INEMA) for implementations in priority areas of Caatinga's conservation, some of them already with the license and other with the license in progress.

Companies like Atlantic Energias Renováveis S.A., Campo Formoso I Energias Renováveis S.A., Ventos dos Guarás I Energias Renováveis S.A., Morrinhos Energias Renováveis S.A. and Andorinha Energias Renováveis S.A. in Campo Formoso city, are inside priority conservation areas, characterized by high biological importance in the extremely high action priority class, which destination recommendation, given by the Ministerial Ordinance, is the creation of an Integral Protection Conservation Unit (Brazil, 2018).

In accordance with Fonseca et al. (2017) a total of 282 priority areas of conservation were catalogued, corresponding to 36.7% of the Caatinga territory. The definition of these areas was defined with the occurrence of what specialists call "conservation targets", which are endangered fauna or flora species and even alternative habitats, considered essential for the survival of species.

Still in accordance with the authors mentioned before, from the 282 catalogued areas, 73 are in Bahia's territory, corresponding to 43% from the priority conservation areas.

Neri et al. (2019) verified that until 2018's beginning, 6.313 wind turbines worked in Brazil. 78% from these turbines were installed in Caatinga's area and 47%, corresponding to more than five million hectares, on areas mapped by the MMA (Brazil, 2018) for this biome conservation.

Analysing the projections for new wind turbines installation, the authors mentioned above, verified that others 14.696 new wind turbines probably would be installed, and 5.570 from these would advance on priority conservation areas of Caatinga. Most of them in areas considered as 'very high' and 'extremely high conservation priority' due to the high degree of endemism and the incidence of endangered species (Brazil, 2018).

Neri et al. (2019) estimate that an area of 11.6 million hectares of Caatinga, which corresponds to 13% of this ecosystem, characterized by the state itself as a priority for biodiversity conservation, will be occupied by wind farms. The authors do not include in these data the areas necessary for the implementation of transmission lines, which the projects are generally licensed separately.

Following the qualitative analysis about the environmental license for wind farms, it is observed the occurrence of endangered fauna species, such as bats and parrots. As stated by UICN's (União Internacional para Conservação da Natureza) standards, all seven species of bats considered endangered in Brazil, occur in Bahia backwoods ridges (CEMAVE / ICMBio, 2020).

Another example is the *Anodorhynchus leari* Bonaparte, 1856, endemic endangered specie from Caatinga (Fig. 2). According to (Lugarini et al., 2012), this specie is proven to be distributed in the cities: Canudos, Jeremoabo, Euclides da Cunha, Paulo Afonso, Sento Sé, Campo Formoso, Monte Santo e Santa Brígida, where wind farms are being licensed.



Fig.2. *Anodorhynchus leari* Bonaparte (*Psittacidae*), 1856.

Source: J.A. Siqueira.

This parrot, along with its mind food, the *Syagrus coronata* (Mart.) Becc., are protected by National Action Plan (Plano de Ação Nacional - PAN) for the conservation of *Anodorhynchus leari* (Lugarini et al., 2012).

Another species of parrots considered endemic and with proven occurrence in the region is *Cyanopsittaxixii*. One of the most endangered species of the world, (ICMbio, 2020), *Cyanopsittaxixii* is also protected by a national plan that counts on public investment for its execution, the National Action Plan for the conservation of this specie (Barros et al., 2012).

According to the Red Book of Endangered Brazilian Fauna (Livro Vermelho da Fauna Brasileira Ameaçada de Extinção)(MMA, 2008), although the species are in a terminal phase, there is still hope that it can be reestablished in the environment from which it was eradicated. Nevertheless, this return depends on efforts and political decisions that enable the complex process of release and readaptation.

It is observed, therefore, that CONAMA Resolution 462, 2014 (CONAMA, 2014) is being ignored by the licensing agency of the state of Bahia, Brazil. The aforementioned Resolution determines that:

*It will not be considered of low impact, requiring the presentation of an Environmental Impact Study and Environmental Impact Report (EIA/RIMA), in addition to public hearings (...), wind farms that are located (...):*

*V - in regular areas of route, landing, rest, feeding and reproduction of migratory birds contained in the Annual Report of Migratory Birds Routes and Areas of Concentration of Migratory Birds in Brazil, emitted by Chico Mendes Conservation of Biodiversity Institute – ICMbio, within 90 days.*

*VII – in areas of endangered species and areas of restricted endemism, according to official lists (CONAMA, 2014).*

In July 2021, Bahia's Public Prosecutor's Office recommended that the French company Voltalia halt the construction of the Canudos Wind Complex and that INEMA cancelled their environmental license. One of the reasons that justified this decision is that this company was located in an area of *Anodorhynchus leari*'s route (MINISTÉRIO PÚBLICO DA BAHIA, 2021). In addition, more than 70 associations and entities have prepared a Public Charter to expose the concern of civil society and charge attitude of the authorities. (Barrero, Marques, Oliveira, et al., 2021).

The threat that wind farms offer to birds in general is the risk of death by collision with the moving parts of wind turbines (Bonfim& da Silva, 2021; Erickson et al., 2014; Frenz, 2016; Manville, Albert M., 1998). According to Barrero, Marques, & Freitas (2021), each tower has a set of three blades that move circularly in a vertical area of about 2 hectares for decades, without interruption. The higher number of wind turbines, higher is the probability of death by collision.

Considering the 1.069 wind turbines in environmental license process in Tombador ridge, for example, the airspace that could offer risk corresponds to an area 21.380.000 square meters. As an aggravating factor, some species have the behaviour of flying in flocks, being able to collide with the blades of the wind turbines at once, as is the case of *Anodorhynchus leari*(Lugarini et al., 2012).

During the analysis that based this paper, it was revealed that the Executing Agency of the State Policy for the Environment and Biodiversity Protection in Bahia, which is also responsible for giving environmental licenses (INEMA) has been assuming a flexible approach in relation to wind farms. The agency's way of proceeding worries civil society organizations and the Public Prosecution of Bahia, which has been investigating and recommending corrections in the licensing process for the good of the community and the conservation of biodiversity.

The problems found in the licensing process in Bahia backwoods ridges (Barrero, Marques, & Freitas, 2021; Barrero, Marques, Oliveira, et al., 2021) reflects negatively on an important centre of biodiversity and endemism (Siqueira Filho & Lira, 2021) that, despite suffering from the effects of drought, still provides for about one million people in the Brazilian semi-arid region (Conceição, 2021; Marques et al., 2021) and directly reflects on local communities, where wind farms are installed.

The consequences of this wind projects model of implantation are also revealed in the anthropic sphere. Bahian communities, many of them recognizably traditional (Alcântara & Germani, 2009; Germani, 2021), located in areas that have wind potential, are often surprised by the visit of representatives of large wind farms. These representatives use moral harassment, creating false expectations and causing frustrations in residents of these communities. Among the false expectations reported by people of the communities, it can be mentioned substantial income from participation in the energy business, income from traditional land leases, jobs and other individual or collective promises (Ribeiro, 2021; Traldi, 2021).

Because of this exposure to which communities are subjected, it is increasingly common for conflicts to occur between local residents, historically united by ties of friendship, kinship or cronyism.

The absence of supervision by the State in relation to the actions of wind companies that happened in Bahia's backwoods ridges was also observed in Mexico by Huesca-Pérez et al. (2018). The authors detected conflicts between the populations, the state, and the companies when analysing the socio-environmental impact of wind farms on communities and indigenous peoples in the Isthmus from Tehuantepec.

To enable the implementation of wind farms, one of the conditions is the guarantee of a properly regularized physical space that accommodates the parks with wind turbines, access roads, transmission lines and other necessary improvements. For this purpose, one of the most common ways is to rent the land traditionally occupied by local residents (Ribeiro, 2021). As, normally, the local residents do not have the title deed and even enough education enough to ensure its regularization, interested companies end up making themselves available to perform this service, often assuming the condition of attorney for the farmers possessors.

Once the area is regularized, a rent contract is elaborated with clauses that favour the companies' interest more than the families' who historically owns the land. Unassisted and helpless by the State, families feel obliged to agree to abusive clauses (that they are not even aware of) of these contracts, such as the period of validity that generally is very long, and confidentiality clauses.

In addition to the contractual issues that formalise the relationship between companies and local residents, the presence of wind companies changes the environmental balance directly affecting local communities.

Among these interventions, it is highlighted the noise pollution, caused by the intense traffic of machines, small

vehicles, and the noise from wind turbine blades. Air pollution, caused by dust from soils without vegetation for the operationalisation of the enterprise besides the constant traffic of vehicles, including trucks and heavy machinery.

The gaps left by Bahia State about the environmental licensing for wind enterprises, points out to an inadequate permissiveness to wind companies advancing over vulnerable areas. It also promotes asymmetric negotiations with local communities, some of which are recognised as traditional: Fecho e fundo de Pasto Community, Quilombola Communities, and Indigenous Villages (Ribeiro, 2021).

Valença & Bernard (2015) compared the American, Canadian and Portuguese environmental licensing of the wind enterprises with Brazilians'. Their conclusion is that the environmental legislations of these countries for this type of enterprise are inadequately permissive to companies operating as renewable energy. Even so, Brazilian legislation is even more fragile and permissive than that of the countries analysed, as observed by the authors.

Furthermore, Valença & Bernard (2015) evaluate that one of the gaps in Brazilian environmental licensing is the possibility of fractionating large wind complexes into smaller wind farms, a situation that, as clarified above, allows simplified and unrigorous studies to be presented, instead of robust studies that ensure the maintenance of ecological balance and the safety and well-being of the population.

Nevertheless, it is important to consider that carrying out detailed studies is not a guarantee that this maintenance will effectively occur, as Bernard et al. (2014) state. These authors consider that the requirement and preparation of EIA/RIMA, for example, does not necessarily imply the elimination of failures in the environmental licensing process. The poor procedure of these studies, the authors emphasise, can result in the underestimation of the real impacts arising from the installation and operation of wind farms on flying wildlife, such as birds and bats, as well as on the life of society in general.

Biases arising from poor procedure or poor evaluation of these studies end up being legitimised or validated by the State itself, making it even more difficult for civil society organisations to manifest in order to discipline the irregular advance of these wind complexes.

Environmental Impact Studies (EIA) of wind projects, whether in Brazil or in countries such as the United States, Canada and Portugal, are unsatisfactory and cannot prevent significant environmental damage such as soil erosion, pollution and siltation of rivers and lakes, damage to flora, fauna and human beings. (Bernard et al., 2014; Valença&

Bernard, 2015). As rule of thumb, these authors also verify that the synergistic and cumulative effects of smaller adjacent wind enterprises are disregarded in these countries.

Valença & Bernard (2015) consider that environmental agencies cannot ignore the cumulative effects of adjacent wind farms. According to these authors, the contiguous installation of parks can cause, in practice, a greater effect than that provided individually in the reports of each park.

According to Neri et al. (2019) with regard to state and federal laws in Brazil defining criteria, commitments and compensation for maintaining balance in ecosystems, large energy conglomerates seek to reduce the costs of implementing these projects to maximise profits from their operation.

Valença & Bernard (2015) claim that wind companies define on their own the effort and investment they intend to dedicate to conservation actions according to the legal weaknesses found on each Brazilian state. This explains the slowness in creating Conservation Units in promising regions for these companies. The difficulty in creating more restrictive and therefore more effective Conservation Units for Biodiversity conservation, such as National Parks and Biological Reserves, for example, is even greater.

The Boqueirão da Onça National Park (PARNA), created by Federal Decree 9.336 of April 5, 2018, aiming the full protection of biodiversity, covers municipalities located in areas with abundant winds, such as Sento Sé, Juazeiro, Sobradinho and Campo Formoso. According to Siqueira Filho et al. (2021), originally, before the publication of the decree, it was planned the full protection of an area of about 820.000 hectares (Siqueira Filho et al., 2015). After 12 years of negotiations with the energy sector, PARNA was reduced to less than half (347.557 hectares) which polygonal is not consistent with the arrangement of the communities of the Caatinga biota to which the park should protect (Siqueira Filho et al., 2021). However, it is observed that the layout of the park reserves the most promising areas for wind exploitation, which allows us to conclude that its layout served the interests of wind enterprises instead of protecting biodiversity.

According to the analyses made so far, there is great commitment of wind companies to camouflage themselves as simple enterprises, free of significant environmental impacts, when, in fact, they are fragmented mega-enterprises. These forms of fragmentation can be understood with the following aspects:

Initially, deciding to separate the Wind Complex into two phases: generation and transmission of energy, which

already constitutes an improper simplification of a highly complex endeavour.

To divide the power generation phase into almost a hundred wind farms and sub-parks with a maximum of 15 wind turbines each.

To ignore the synergistic and cumulative effect of these wind farms and sub-parks, analysing them individually.

As if that were not enough, these wind farms are still advancing on vulnerable areas, threatening biodiversity and the communities installed there.

Interestingly, these failures went unnoticed by the licensing agency of Bahia. It is possible to reverse the situation in the ongoing environmental licensing processes, as well as in future ones. However, the doubt remains about the licenses already issued: would it only be left for present and future generations the regret of irreversible loss of biodiversity and endangered and endemic species? Or is there still a way to minimise the failures committed? It is understood that the first challenge is to recognise by the state that there were failures in the environmental licensing process.

#### IV. CONCLUSION

It is concluded that a state policy is underway in Bahia that relaxes the environmental licensing process of wind projects. One of the aspects of this flexibility with a broader reflection is the fractionation of large or exceptional enterprises into micro and small enterprises, contrary to the current legislation that explicitly prohibits this type of conduct. It is understood that this state policy endangers the semiarid ecosystems where watersheds of recognised relevance are located, such as the basins of the Itapicuru, Salitre, Paraguaçu and São Francisco Rivers (Marques & Wagner, 2021).

The flexibility observed during the research does not occur only in Bahia, it is also observed by other scientists, both in research developed in Brazil and abroad, indicating a global trend of replacing the usual energy sources by renewable sources.

As one of the Brazilian states with the greatest wind potential, it is up to INEMA, the executing agency of the State Policy on the Environment and Biodiversity Protection and the State Water Resources Policy (Bahia, 2006), to signal paths that serve as a reference for the other states of the federation. Considering this context, the organisation can take the lead in an energy reform in the country, requiring greater commitment from investors, charging the use of cleaner and more efficient technologies, as well as guiding so that the distribution of these enterprises does not negatively affect the ecosystem balance, nor the local populations



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# Socio-environmental effects linked to industrial and port activities in Barcarena, Pará, Brasil: the case of Cuipiranga, ilha Trambioca

## Efeitos socioambientais ligados as atividades industriais e portuárias em Barcarena, Pará, Brasil: o caso de Cuipiranga, ilha Trambioca

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**Keywords**— *Traditional Communities, environment, vulnerabilities.*

**Palavras-chave**— *Comunidades Tradicionais, meio ambiente, vulnerabilidades.*

**Abstract**— *This research aimed to diagnose and analyze the socio-environmental effects related to industrial and port activities in the municipality of Barcarena, Pará in the Cuipiranga community, Trambioca Island from the eyes of residents living in this territory. The methodological procedure was carried out the field research, with the collection of data occurred with eighteen (18) residents, through online questionnaires and semi-structured interviews. For data analysis, triangulation of methods was used. The results of the research reveal that the great estimate of environmental accidents that occurred at the site caused by industrial and port companies, have affected the life, health, source of income and traditional knowledge of the community, therefore, it is noticeable that these accidents affected an entire social organization in which residents are inserted, exemplifying the situation of the environment that has been altered and, community way of life.*

**Resumo**— *Esta pesquisa objetivou diagnosticar e analisar os efeitos socioambientais ligados as atividades industriais e portuárias no município de Barcarena, Pará na comunidade Cuipiranga, ilha Trambioca a partir do olhar dos moradores que habitam neste território. Como procedimento metodológico realizou-se a pesquisa de campo, com a coleta de dados ocorrida junto a dezoito (18) moradores do local, por meio de questionários on line e entrevistas semiestruturadas. Para análise de dados utilizou-se a triangulação de métodos. O resultado da pesquisa*

*revelam que a grande estimativa de acidentes ambientais ocorridos no local causados pelas empresas industriais e portuárias, têm afetado a vida, a saúde, a fonte de renda e os saberes tradicionais da comunidade, portanto, é perceptível que esses acidentes afetaram toda uma organização social na qual os moradores estão inseridos, se exemplificando na situação do meio ambiente que foi alterado e, conseqüentemente o modo de vida dos comunitários.*

## I. INTRODUÇÃO

O município de Barcarena apresenta destaque no contexto local do estado do Pará, em função dos projetos industriais e atividades portuárias. A instalação de empresas de transformação mineral na Vila do Conde (décadas de 1980 e 1990) ocasionou o crescimento populacional que veio se dando de forma intensa, justamente por esses projetos desenvolvimentistas disporem de atrativos, os quais vêm causando diversos problemas socioambientais (SILVA & BORDALO, 2010).

Por ter grande parte de seus moradores residentes de áreas ribeirinhas e rurais, o município caracteriza-se como diretamente ligado a natureza e ao extrativismo de seus recursos. Porém, com a ascensão do polo industrial de Barcarena e das empresas de beneficiamento, houve uma quebra na relação dos moradores com a natureza, por causa dos vários acidentes envolvendo as empresas e a poluição dos recursos naturais.

Assim afirmou Silva, et. al. (2018) que como consequência do crescimento desordenado e da falta de um planejamento de crescimento sustentável a contaminação dos ecossistemas tem causado sérios impactos ambientais para o município e sérios prejuízos às comunidades remanescentes das margens dos rios e furos que cortam a região afetada.

No nível de interferência mais direta encontra-se a Indústria metalúrgica, especificamente o caso da ALBRAS em Barcarena, Pará-responsável pelo processo de fabricação de alumínio. Os seus insumos comportam riscos ambientais sérios, além dos riscos específicos sobre a saúde e a própria vida dos trabalhadores. Na ALUNORTE em Barcarena ocorre um processo extremamente poluidor, com emissão da “lama vermelha”, a qual contém enxofre, criolita e soda cáustica. (HÉBETTE, 2004)

Neste município são recorrentes os despejos de efluentes, rejeitos e resíduos nos rios, igarapés e afluentes, gerados nos diferentes processos produtivos das empresas instaladas na região, bem como os acidentes e desastres ambientais, afetando a qualidade da água, onde muitas famílias, ainda utilizam para o consumo, preparos de alimentos, higiene corporal e lazer no entorno das praias da região como Beja, Caripi e Cuipiranga.

Estudos realizados por Santos (2019) comprovam que o município foi alvo de 19 (dezenove) desastres

ambientais ligados à atividade industrial nos últimos anos, resultando em implicações na saúde das pessoas, especialmente nas comunidades tradicionais como destaca o estudo de Silva e Hazeu (2019).

Diante da exposição da população de Barcarena, Pará, em especial dos Povos e Comunidades Tradicionais que ainda utilizam os recursos naturais para a sua sobrevivência, questiona-se até que ponto os moradores da região foram afetados com as atividades industriais e portuárias instaladas no município de Barcarena, Pará?

Assim, objetivou-se diagnosticar e analisar os efeitos socioambientais em decorrência deste processo na comunidade Cuipiranga, ilha trambioca a partir do olhar dos moradores que habitam neste território.

## II. MÉTODOS

A pesquisa teve abordagem qualitativa (SILVA, et al.; 2018) e se desenvolveu com base em um Estudo de Caso (SEVERINO, 2007). Como procedimento metodológico foi realizada pesquisa de campo entre os meses de julho e agosto de 2021 na comunidade Cuipiranga, ilha Trambioca, a qual possui cento e quatorze (114) famílias, segundo informações do Agente Comunitário de Saúde (ACS).

De acordo com Simonian (2006) a Ilha Trambioca localiza-se a Oeste da área esturiana do rio Amazonas, sendo banhada pelas baías de Carnapijó a Leste e de Guajará a Oeste, estando ao norte da cidade de Barcarena, Pará na outra margem do rio Mucuruçá ou Barcarena e Aititeua ou Arrozal. (...) o solo, a vegetação e a fauna são típicos de várzea, com áreas de mangais, que também contam na parte central com floresta de terra firme; (...) É de se ressaltar, ainda, a beleza paisagística da ilha, em especial de suas áreas praianas. A mesma está situada a, aproximadamente, trinta (30) minutos de ônibus e dez (10) minutos de barco da sede do município de Barcarena, tendo como cartão postal a praia de Cuipiranga, que é banhada pela baía do Guajará.

A pesquisa na comunidade Cuipiranga ocorreu após o consentimento e autorização do público-alvo, por meio do Termo de Consentimento Livre e Esclarecido (TCLE), respeitando os aspectos éticos da pesquisa e a coleta de dados ocorreu em dois momentos: 1) O primeiro momento se deu através de um questionário virtual encaminhado aos moradores da comunidade Cuipiranga que tinham um

aparelho celular com acesso à *internet*. Nesta etapa participaram 11 (onze) moradores. No segundo momento, foi realizada uma entrevista semiestruturada (GUAZI, 2021) com 07 (sete) moradores sobre os efeitos socioambientais ligados às atividades industriais, tendo como ferramenta a utilização de um roteiro de perguntas previamente elaborado com vista a nortear o processo de entrevista, as quais estavam distribuídas entre perfil social dos moradores, às mudanças (ambientais, sociais) na comunidade; rotinas de trabalho; e sobre as interferências causadas pelos acidentes ambientais na vida dos comunitários.

O método de análise se deu através da triangulação de métodos com base em Marcondes e Brisola (2014).

### III. RESULTADOS E DISCUSSÕES

O município de Barcarena, por se tratar de um polo industrial, decorrente de sua atividade de transformação mineral das empresas Alumínio Brasileiro S.A (Albrás), Alumina do Norte do Brasil S.A (Alunorte) e Imerys, vem sendo palco de diversos acidentes ambientais. Dessa forma, expõe a fragilidade da gestão ambiental, particularmente a hídrica, tanto por parte das empresas, como dos órgãos fiscalizadores, de âmbito estadual e municipal. (...) (SILVA, 2012)

Segundo estudos de Silva; Hazeu (2019) Barcarena recebeu desde os anos 1980 projetos de portos para exportação de alumina e alumínio, de caulim, de gado vivo e soja, industriais de beneficiamento de bauxita e de caulim, infraestruturas como estradas, linhões e minerodutos, com presença de multinacionais como Vale, Hydro, Burge, Imerys, Yara, Tocantins, Tecop, entre outros (HAZEU, 2015). Os principais afetados por essas atividades são as comunidades e os povos tradicionais que mantêm uma relação direta com a natureza e, por conseguinte, têm sofrido com a poluição e contaminação dos rios (derramamento de lama vermelha, caulim, substâncias químicas oriundas do processo de industrialização, agrotóxico, soja, minério etc.), a desertificação e a infertilidade dos solos, a descaracterização da vegetação, poluição do ar (CARMO et al., 2016) e processos permanentes de desapropriações, deslocamentos forçados, ameaças e cerceamento (HAZEU, 2015).

As entrevistas realizadas com os moradores da comunidade tradicional Cuipiranga do referido município contou com um público na faixa etária dos 15 aos 77 anos de idade, sendo que quatro (4) tinham entre 15 e 27 anos; sete (7) tinham entre 32 e 49 anos e seis (6) tinham entre 60 e 77 anos. Desses, em relação ao questionário virtual, 63,6% eram do sexo feminino e 36,4% eram do sexo masculino; e entre os moradores entrevistados *in lócus*, dois (2) eram homens e cinco (5) eram mulheres. +

Entre as profissões exercidas por eles, no questionário *on line*, 18,2% dos informantes eram pescadores e 81,8% tinham outras profissões; na entrevista *in lócus*, dentre os sete (7) entrevistados, três (3) eram pescadores, duas (2) eram aposentadas, uma (1) era vendedora de açaí e uma (1) era funcionária pública. Todos os entrevistados afirmaram morarem a mais de uma década na referida comunidade, o que torna pertinente avaliar suas experiências pré e pós os acidentes ambientais ocorridos no município.

Em relação ao grau de escolaridade dos informantes, levando em conta o questionário virtual, 36,4% dos participantes tinham o ensino médio completo; 27,3% tinham o fundamental completo e a mesma porcentagem para os que possuíam ensino superior; e 9,1% dos informantes tinham o ensino fundamental incompleto; agora, levando em consideração a entrevista *in lócus*; quatro (4) entrevistados possuíam o ensino fundamental incompleto; uma (1) tinha o ensino médio completo e uma (1) tinha o ensino superior incompleto.

Foi perguntado aos moradores como era a comunidade na infância deles, ou quando eles chegaram, em geral, as respostas foram voltadas a pacificidade da região, com poucas casas e moradores; e as dificuldades encontradas nas ruas sem asfalto, na falta de energia elétrica, de água encanada e de locomoção. Situação essa que é bastante comum nas áreas rurais, por conta de sua distância da sede municipal.

Segundo os dados da pesquisa, os informantes da comunidade Cuipiranga afirmam que a comunidade foi modificada após e por causa dos acidentes ambientais que ocorreram no município principalmente na questão ambiental, com o desaparecimento do pescado que é a maior fonte de renda dos moradores; sofreu modificações também na questão do turismo na região, devido a praia de Cuipiranga ser um ponto turístico do município e após os acidentes que contaminaram as águas da região, o fluxo de visitantes reduziu bastante, sobretudo, em decorrência da contaminação da praia e dos rios. Uma das moradoras relata o seguinte:

“O peixe falhou, ele (o marido) trabalha com peixe, e aí eu trabalho com açaí mas também não tinha pra quem vender (...) falaram que tudo tava contaminado até o peixe, então ninguém vinha comprar, era uma luta pra vender um peixe, eles achavam que o peixe também tava contaminado”.  
(VENDEDORA DE AÇAÍ)

Questão essa, que reafirma o temor dos turistas e visitantes às comunidades, e a negligência por parte da Vigilância em Saúde Ambiental aos moradores da região, conforme pontuou Pantoja; Queiroz e Cordeiro (2020)

Estudos realizados por Silva; et. al (2018) sobre o teor de metais pesados nos peixes do rio Murucupi, no município de Barcarena, o qual demonstrou elevados níveis de metais determinados nas amostras coletadas por ocasião do acidente ambiental. Observa-se nos resultados níveis muito acima do limite estabelecido pelos padrões de referência. Para o Fe (ferro) observa-se valores 23,9 vezes maior que o estabelecido pelo WHO (1993), indicando que as espécies da área atingida estão expostas a elevados níveis deste metal, e, o seu importante papel biológico, não o descaracteriza como tóxico quando em elevados níveis.

Vale ressaltar nesse contexto a importância da Vigilância em Saúde Ambiental, no que diz respeito a contaminantes ambientais que tem como principal função atuar realizando mapeamento das áreas de risco com foco no território, mantendo a constante vigilância dos contaminantes, de forma a minimizar os riscos de doenças decorrentes da exposição aos mesmos, quer seja na atmosfera, coleções hídricas ou no solo, no sentido de contribuir para melhorar a qualidade de vida do ser humano do ponto de vista da sustentabilidade. (BRASIL, 2004). (OLIVEIRA; VIANA & SANTANA, 2021)

Foi questionado aos moradores também sobre sua fonte de renda financeira, dos quais, em relação ao questionário virtual, três (3) responderam que vive ou é beneficiado de trabalho assalariado, oito (8) vivem ou são beneficiados da pescaria, e em relação a entrevista *in lócus*, cinco (5) moradores tem sua fonte de renda diretamente ligada a pescaria, e dois (2) tem sua fonte de renda indiretamente ligada a pescaria. Todos afirmam que após os acidentes ambientais modificou a rotina de trabalho pelo fato da contaminação dos rios e dos animais aquáticos; e dezessete (17) moradores, de um total de dezoito (18) entrevistados afirmaram que houve grandes modificações e apenas um (1) informantes alegou não ter havido grandes modificações. Nessa concepção, percebe-se a ligação da comunidade com extrativismo dos recursos naturais, principalmente do pescado que, de acordo com a pesquisa, é um dos principais meios de fonte de renda e alimentação dos comunitários. Sendo assim, é notável a dificuldade enfrentada por esses informantes após os acidentes que comprometerem a sua fauna, principalmente pela contaminação das praias e rios, o que consequentemente contaminou seus peixes e mariscos.

O que corrobora Silva e Hazeu (2019) quando afirmam que a poluição e os desastres/crimes ambientais causados pelas empresas, apoiadas pelo Estado, têm interferido na forma de organização social e econômica dos

moradores das comunidades tradicionais, transformando seu modo de viver, afetando a saúde, suas condições e concepções de saúde.

Quando lhes foi perguntado se a rotina de trabalho melhorou ou piorou após os acidentes na região, no questionário virtual, dez (10) relataram que piorou a rotina de trabalho: "por que com a falta do turismo na ilha o comércio parou e isso agravou a renda das pessoas" citou uma entrevistada. Relataram que o peixe ficou mais "escasso"; e relataram também que algumas coisas melhoraram por conta dos benefícios recebidos, porém pioraram por conta da contaminação; e apenas uma (1) pessoa relatou que não alterou sua rotina de trabalho. E em relação a entrevista *in loco*, todos os entrevistados afirmaram ter alterado sua rotina de trabalho, como afirma um morador "Mudou, muita falta de peixe, que é o nosso meio de vida. Piorou, com certeza."

Como afirma Castro (2019) no Dossiê de Desastres e Crimes da Mineração em Barcarena, Mariana e Brumadinho, que a impossibilidade de trabalho decorre de mudanças no ambiente, desde poluição à perturbação na cadeia ecológica, com o aumento do desmatamento, a perda da biodiversidade, a poluição de cursos d' água e a contaminação da terra e do ar. As pesquisas têm mostrado que a instalação de um megaprojeto de mineração encerra uma complexa operação para identificar as escalas de atuação dos empreendimentos, e as contradições implícitas na relação com as comunidades e os poderes locais (ZHOURY; BOLADOS; CASTRO, 2016)

Assim, corrobora os estudos de Nazaré, Nascimento e Penha (2018, pág. 111) no qual foram entrevistados moradores de sítios de Barcarena que ficam aos arredores dos empreendimentos da Hydro e Alunorte, e um informante cita que:

"O igarapé Cajueiro, braço do Murucupi, sempre foi uma fonte de vida, de onde tirávamos água para beber, tomar banho e pescar, mas é hoje fonte de preocupação pelas incidências dos desastres ambientais causados pelos rejeitos de metais oriundos da empresa Hydro como outros acidentes que já ocorreram na região matando muitos peixes. (E.M.S.S. de 67 anos)."

Nesse sentido, foi perguntado aos moradores se houve mudança na obtenção sobre a sua fonte de renda após os acidentes ambientais; sobre essa questão, em relação ao questionário virtual, oito (8) entrevistados afirmaram ter

havido mudança na obtenção da sua renda financeira, e três (3) dos informantes alegaram não ter havido nenhuma alteração na sua renda; e em relação aos moradores entrevistados pessoalmente, todos alegaram ter alterado a obtenção da sua renda após os acidentes ambientais ocorridos no município. Como um morador que é pescador afirma:

“Hoje em dia só da pesca não se vive mais, se não tiver outro ganho fora. Viver vive, mas vai passar fome um dia, vai comer no outro, vai ser assim. Como vivia antigamente não se vive mais não. Antigamente todo mundo sobrevivia da pesca aqui, o trabalho daqui era a pesca, hoje tem que fazer alguma coisa por fora.”  
(PESCADOR)

Essa questão reverbera no distanciamento das pessoas que viviam apenas da subsistência da natureza, da pesca, da lavoura, da agricultura, e que agora necessitam de um outro meio para manter sua fonte de renda, no qual, os que tem condições (pessoas mais jovens da comunidade) procuram o trabalho assalariado em empresas, supermercados e etc. Assim, a comunidade se encontra cada vez mais afastada dos saberes tradicionais relacionados aos trabalhos do campo, construídos ao longo das gerações. Uma professora da comunidade relata o seguinte:

“Trabalho na escola, não afetou meu trabalho, mas afetou os pais dos alunos que são pescadores e comerciantes e sobrevivem dessa renda.”  
(PROFESSORA)

Percebe-se as ligações sociais e emocionais bem presentes na comunidade, nas quais os comunitários se percebem, inseridos e afetados pelo contexto social vivido.

Silva & Hazeu (2019) afirmaram que as atividades industriais e portuárias interferem no espaço onde comunidades realizam suas atividades de pesca, coleta, agricultura, vida comunitária e lazer. Nesse sentido, vale ressaltar que é inimaginável os impactos que essas atividades industriais e portuárias, com sua estimativa de acidentes e contaminação no município têm causado a uma comunidade que tira sua subsistência da natureza.

#### IV. CONCLUSÃO

Conclui-se que a grande estimativa de acidentes ambientais ocorridos na região e causados por esses empreendimentos, têm afetado a vida, a saúde, a fonte de renda também os saberes tradicionais da comunidade,

portanto, é perceptível que esses acidentes afetaram toda uma organização social na qual os moradores estão inseridos, se exemplificando na situação do meio ambiente que foi alterado e, conseqüentemente o modo de vida dos comunitários.

Os dados coletados na comunidade de Cuipiranga mostrou exatamente essas vulnerabilidades deixadas através dos acidentes/crimes ambientais, nas quais os comunitários ainda sofrem, havendo assim, um descaso com a população em risco.

Nesse sentido seria viável uma estrutura de apoio a região afetada pelos acidentes ambientais, composta por governo municipal, estadual, órgãos de controle social e Vigilância em Saúde Ambiental, para dar suporte, assistência, monitoramento e vigilância contínua as comunidades em risco.

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## Reuse of Polychloride of Vinyl (PVC) for the production of synthetic matapi in a rural community of Igarapé-Miri, Pará, Amazônia

## Reutilização do Policloreto de Vinila (PVC) para produção de matapi sintético em uma comunidade rural de Igarapé-Miri, Pará, Amazônia

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**Keywords**— *Sociotechnical innovation. Local  
Development. Traditional Community.*

**Palavras-chave**— *Inovação Sociotécnica.  
Desenvolvimento local. Comunidade  
Tradicional.*

**Abstract** — *This research aimed to reuse polychloride of Vinyl (PVC) pipes for the production of synthetic Matapi in a rural community in the municipality of Igarapé-Miri, Pará, Amazônia. To make it, the following materials were used: PVC pipes; rope; nylon; an aluminum cooler tube (freezer) and styrofoam. The results indicate that the synthetic Matapi, made in the molds of the traditional matapi, proved to be quite efficient in catching the fish and among its numerous advantages it is that one of them is in the impermeability and resistance of its strips in the water, proving its efficiency and usefulness. With this work it was possible to present an environmentally correct solution for the final destination of PVC pipes that were disposed of inadequately. The result of this experience, however, may serve as an example for local communities, Non-Governmental Organizations (NGOs), municipalities and schools that find in discarded PVC and other solid waste, an opportunity to raise awareness, conserve the environment, enable income generation, and build local development strategies.*

**Resumo**— *Esta pesquisa objetivou reutilizar tubos do Policloreto de Vinila (PVC) para a produção de Matapi sintético em uma comunidade rural do município de Igarapé-Miri, Pará, Amazônia. Para confeccioná-lo utilizou-se os seguintes materiais: tubos de PVC; corda; nylon; um tubo de alumínio do refrigerador (freezer) e isopor. Os resultados apontam que o Matapi sintético, confeccionado nos moldes do matapi tradicional, se mostrou bastante eficiente na captura do pescado e dentre suas inúmeras vantagens destaca-se que uma delas está na impermeabilidade e resistência de suas tiras na água, comprovando sua*

eficiência e utilidade. Com este trabalho foi possível apresentar uma solução ambientalmente correta para a destinação final dos tubos de PVC que eram descartados de forma inadequada. O resultado desta experiência, entretanto, poderá servir de exemplo para comunidades locais, Organizações Não Governamentais (ONGs), prefeituras e escolas que encontrem no PVC descartado e demais resíduos sólidos, uma oportunidade de conscientizar, conservar o meio ambiente, possibilitar geração de renda e construir estratégias de desenvolvimento local.

## I. INTRODUÇÃO

O Policloreto de Vinila (PVC) também conhecido como cloreto de vinila ou policloreto de vinil; (da sua designação em inglês *Polyvinyl chloride*), nome IUPAC policloroeteno, de fórmula molecular  $(C_2H_3Cl)_x$  é um dos polímeros sintéticos de plástico (termoplástico) mais produzidos no mundo. A demanda por este polímero está crescendo de forma constante e tem sido impulsionada pelo aumento de investimento em projetos de construção e infraestrutura (SALASINSKA; *et. al.*; 2021) consequentemente também se evidencia o aumento da produção de resíduos deste material e presentes em várias comunidades rurais da Amazônia estão em processo de transformações e modernização.

O PVC é único por ser um material plástico que não é totalmente originário do petróleo, contendo, em peso 57% de cloro derivado do cloreto de sódio (sal marinho ou da terra) e 43% de eteno derivado do refino do petróleo e do gás natural. É por meio da eletrólise do cloreto de sódio, que se obtém a composição cloro da resina de PVC. Considera-se que ele seja mais econômico e térmico em termo de uso dos recursos não renováveis. (SILVA & ARAÚJO, 2021)

A descoberta do Cloreto de Vinila (VC), cujo nome IUPAC é cloroeteno (monômero do PVC) de fórmula química  $(C_2H_3Cl)$ , ocorreu em 1835 por *Justus Von Liebig* através. No entanto, os primeiros registros de polimerização – PVC ocorreram em 1872, por um cientista chamado *Eugen Baumann*, que observou a formação de um pó branco ao expor um gás, o VC, à ação dos raios solares durante vários meses em recipiente fechado. Este polímero foi patenteado pela primeira vez em 1913, no entanto, foi somente em 1931, na Alemanha, que surgiu o interesse comercial por esta nova resina e consequentemente teve início a sua produção industrial em 1933. (MARTINS & RODRIGUES (2021); (TURNER & FILELLA, 2021)

“No Brasil, o polímero começou a ser fabricado comercialmente em 1954 e no ano de 2017 sua demanda no mundo foi de 43 milhões de toneladas o que equivale a cerca de 72% da capacidade produtiva, sendo que a maior demanda por esse material se encontra no Nordeste Asiático (46%), e, a menor na América do Sul, (4%) (o

Brasil é responsável por cerca de metade da demanda da América do Sul).” (SILVA, 2020, p.2)

De acordo com o Instituto Brasileiro do PVC, o policloreto de vinila (PVC) é um produto de grande versatilidade que está presente em nosso dia-a-dia. Suas prioridades, características e relação custo-benefício combinados, revelam suas potencialidades de aplicação em diversas áreas da indústria, sobretudo para a humanidade seja em produtos da área médica e tubos para condução de água e esgoto ou em embalagens de alimentos, calçados, brinquedos, fios e cabos, revestimentos, automóveis, sendo seu maior uso na construção civil. (INSTITUTO BRASILEIRO DO PVC, 2021)

Turner e Filella (2021) afirmaram que a ampla aplicabilidade do PVC com uma grande diversidade de utilizações se deve à sua versatilidade e propriedades de resistência, impermeabilidade, durabilidade, retardamento de chama inerente, excelentes propriedades químicas, mecânicas e capacidade de acomodar uma ampla gama de aditivos através de sua alta polaridade. De acordo com Lucht (2020) o PVC aparece como um forte competidor, devido seu excelente custo-benefício, apresentando-se com inúmeras vantagens em relação a materiais como madeira, metais e cerâmicas.

Bavaresco, *et. al.*, (2016) destacaram que sua utilidade contribui para a preservação ambiental, pois vários produtos da natureza podem ser substituídos pelo PVC, como por exemplo, a madeira que pode ser substituída para reduzir o desmatamento, entre outros. Sendo uma boa alternativa por serem provenientes de processos menos agressores ao meio ambiente e com premissas de sustentabilidade. Seu material destaca-se pelo fato de oferecer segurança para o ambiente, pois sua composição evita a propagação do fogo, o mesmo já vem pronto, não necessitando uso de pinturas, possuindo boa estética e maior resistência as intempéries, sendo assim de alta durabilidade.

Para se ter uma ideia, o PVC permanece por até seiscentos anos no ambiente natural sem se degradar. A inclusão desse resíduo como matéria-prima para um novo material propicia um novo ciclo de vida, contribuindo para o aumento no percentual de reciclagem deste, que pode ocorrer por vários métodos, além de contribuir para a

diminuição de risco ambiental com descartes inadequados ou em aterros e explorando sua propriedade como retardante de chama. (MARQUES, 2020)

Nessa perspectiva, Santos e Ferrari (2019, p.40) destacam que “a melhor maneira de solucionar os problemas dos resíduos e de eliminá-los, especialmente, é melhorando as técnicas de reutilização, fundamental para a preservação dos recursos naturais.”

Assim, pensando nos benefícios da reutilização do material PVC para o meio ambiente, surgiu o interesse em reutilizá-lo para a produção de matapi sintético em uma comunidade rural no município de Igarapé-Miri, Pará, Amazônia, após observar que havia muitos resíduos nos quintais das residências, podendo até mesmo acumular água parada e servir de criadouros para mosquitos.

De acordo com Lima, Bastos e Montagner (2016) o matapi sintético é uma alternativa para captura de camarões, com formato similar ao matapi tradicional e ao confeccionado com garrafa PET. Caracteriza-se como uma armadilha tipo covão com funis fixados lateralmente, mas distinguindo-se basicamente pelos materiais utilizados na sua confecção. Tal protótipo é de fácil construção e tem vida útil superior aos tradicionais matapis utilizados no estuário amazônico que são construídos com materiais da floresta e demandam considerável tempo em sua fabricação. No matapi tradicional são utilizadas fibras das palmeiras jupati (*Raphia vinifera* P. Beauv.), bacaba (*Oenocarpus bacaba* Mart.) ou buriti (*Mauritia flexuosa* L. f.), além de fibras do cipó-titica (*Heteropsis flexuosa* (Kunth) G.S. Bunting) da região.

Vale ressaltar que o matapi sintético aqui proposto possui características que distingue dos últimos protótipos já construídos, tendo outras padronizações, métodos e equipamentos de elaboração, com tiras de PVC similar as talas que são confeccionadas com os produtos da floresta, desenvolvido assim nos moldes do matapi tradicional.

## II. MATERIAIS E MÉTODOS

Utilizou-se os seguintes materiais para a confecção do matapi sintético: dois (02) tubos de PVC de circunferência 100 centímetros (cm) e altura de 51 cm cada (medida exata da altura do matapi); corda com 9 metros (m) de comprimento; nylon nº 70 com 8 m de comprimento; tubo de alumínio do refrigerador (freezer). (Fig.1).



Fig. 1: Materiais Utilizados

Inicialmente foram coletados dois (02) tubos de PVC descartados em quintais de uma propriedade rural, onde os mesmos foram higienizados, recortados e divididos ao meio com uma cerra manual. Logo em seguida, foram retiradas as medidas e larguras de tiras a 1 cm cada, para serem recortadas. Os dois tubos de PVC renderam em um total de quarenta e oito (48) tiras, o suficiente para a produção do matapi. Em seguida, as tiras foram emparelhadas em uma superfície plana e tecidas com cordas e nylon originando *a priori* o corpo do matapi. Após isso, foi produzido quatro (04) arcos a partir da reutilização do tubo de um refrigerador (freezer), os quais foram moldados a uma circunferência de 61 cm cada, (medida proporcional à circunferência do matapi), o mesmo teve como função dar sustentação e melhorar a estrutura interna do matapi. (Fig.2 e 3)



Fig. 2: Tubo do Refrigerador

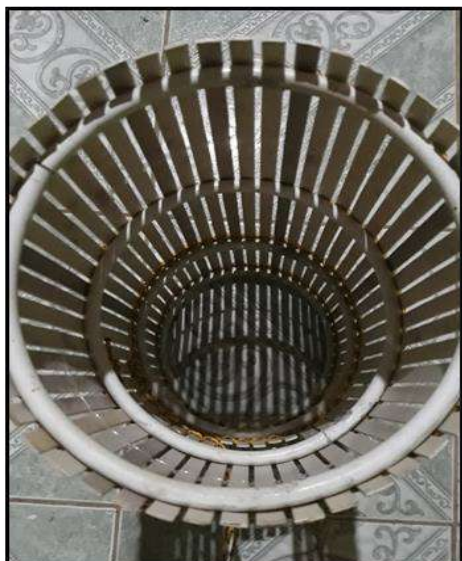


Fig. 3: Estrutura Interna Do Matapi

Em seguida, foram confeccionados dois (02) funis para serem encaixados na extremidade do matapi adotando a mesma técnica de retirar as tiras do tubo de PVC e tecê-las com a corda e o nylon, porém em cortes transversais para que se formassem um orifício na extremidade do funil (local de entrada do pescado). (Fig. 4 e 5)



Fig. 4 E 5: Funil do Matapi

Para finalizar o matapi, foi tecido uma pequena janela com altura de 12 cm, a qual foi fixada no local de abertura que é inserida a *poqueca* (isca que pode conter farelo ou babaçu, entre outros), que é utilizada como suporte para atrair o camarão até o matapi para alimentá-lo e capturá-lo. O matapi sintético pesou em torno de 1 kg (quilo) e 200 g (gramas) por isso foi sobreposto um isopor com 28 cm de comprimento para melhorar a sua flutuação na água. Na Fig 6 é possível observar a sua coloração branca que se deve ao material de PVC utilizado para a sua confecção.



Fig. 6: Matapi Sintético

### III. RESULTADOS E DISCUSSÕES

A Fig. 7 mostra o matapi sintético confeccionado e em experimentação para a captura do camarão de água doce.



Fig. 7: Matapi em Experimentação

Os resultados apontam que o matapi sintético, confeccionado nos moldes do tradicional, se mostrou bastante eficiente na captura do camarão de água doce e dentre suas inúmeras vantagens destaca-se que uma delas está na impermeabilidade e resistência de suas tiras na água que se deve ao fato do material de PVC possuir tais características como ressaltam Turner e Filella (2021) comprovando a sua eficiência e utilidade.

Destaca-se ainda a eficácia de sua estrutura interna que combinado aos demais materiais utilizados como o tudo de refrigerador (*freezer*) trará mais durabilidade ao matapi.

Além disso, a extremidade interna do funil (orifício) não será destruída facilmente, o que beneficiará o pescador, conferindo-lhe maior tempo de uso, pois o funil do matapi em bom estado de conservação evitará a fuga do pescado com facilidade e o material PVC contribui para manter a sua forma, devido a sua resistência, sendo que o ecossistema aquático, contribui ainda mais para o seu tempo de permanência, devido às baixas concentrações de oxigênio e temperaturas reduzidas como pontua Silva (2021), visto que o material PVC só começa a amolecer por volta de 80°C e se decompõe acima de 140°C.

Outro aspecto interessante está na estética do mesmo, apresentando-se com um aspecto sofisticado e consistente. Ressalta-se ainda que o matapi sintético de PVC não favorece a acumulação de resíduos em suas tiras e quando possível podem ser higienizados, pois seu material resiste à pressão mecânica, dependendo da intensidade da força aplicada, além da durabilidade dos materiais utilizados para sua confecção e baixo custo de produção.

#### IV. CONCLUSÃO

Com este experimento foi possível apresentar uma solução ambientalmente correta para a destinação final dos tubos de PVC que eram descartados de forma inadequada nos quintais de uma residência no meio rural. O resultado desta experiência, entretanto, poderá servir de exemplo para comunidades locais, Organizações Não Governamentais (ONGs), prefeituras e escolas que encontrem no PVC descartado e demais resíduos sólidos, uma oportunidade de conscientizar, conservar o meio ambiente, possibilitar geração de renda e construir estratégias de desenvolvimento local.

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## The role of the health professional in chemotherapy treatment in elderly patients

## O papel do profissional de saúde no tratamento quimioterápico em pacientes idosos

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**Keywords—** Elderly, Cancer, Chemotherapy

**Palavras chaves –** Idosos, Câncer, Quimioterapia

**Abstract—** Cancer in the elderly is not just worrying because it is cancer, when there is the development of cancer at an advanced age, other factors end up being taken into account, so that everything is a risk. The objective of the study is to evaluate the role of the health professional in the chemotherapy treatment of elderly patients. The methodology used was the bibliographic review, evaluating texts related to the present subject. In the elderly, the art of persuasion is essential, considering that, often, the elderly, upon discovering that they have cancer, end up refusing to undergo treatment because they think it is not worth it, since they have lived for a long time. So health professionals such as nurses, doctors, pharmacists, psychologists and among other professionals who should try to influence the change of patient opinion in addition to being prepared to support everyone around. The nurse, being the professional with the longest contact time with the patient, must be attentive to every detail, since several complications, due to age, can be recurrent. During chemotherapy, the already fragile health of the elderly tends to get worse, making the entire recovery process difficult. Thus, it is concluded that the health professional

*is fundamental as a base of support and care for the elderly who develop cancer and undergo chemotherapy.*

**Resumo**— *O câncer em idosos não é preocupante somente por ser câncer, quando há o desenvolvimento de câncer em idade avançada outros diversos fatores acabam sendo levados em consideração, de modo que tudo é risco. O objetivo do estudo é avaliar o papel do profissional de saúde no tratamento quimioterápico dos pacientes idosos. A metodologia utilizada foi a revisão bibliográfica, avaliando texto referentes ao presente assunto. Em idosos, a arte de persuadir é essencial, considerando que muitas vezes, os idosos, ao descobrirem, que tem câncer acabam se negando a fazer tratamento por acharem que não vale a pena, já que viveram por muito tempo. Assim os profissionais de saúde como: enfermeiro, médicos, farmacêuticos, psicólogos e dentre outros profissionais que deve tentar exercer influência na mudança de opinião do paciente além de estar preparado a apoiar todos ao redor. O enfermeiro, por ser o profissional com maior tempo de contato com o paciente, deve estar atento a cada detalhe, uma vez que diversas complicações, devido a idade, podem ser recorrentes. Durante a quimioterapia, a saúde já fragilizada dos idosos, tende a piorar muito mais, dificultando todo o processo de recuperação. Assim conclui-se que o o profissional de saúde é fundamental como base de apoio e cuidados dos idosos que desenvolvem câncer e fazem tratamento quimioterápico.*

## I. INTRODUCTION

Cancer is a degenerative disease that occurs with the disordered growth of cells and can encompass more than 100 malignancies, as mutations in cells can cause an aggressive process in adjacent tissues, such as distant organs, very quickly with control, causing the formation of tumors. that can move to other parts of the body. These processes are called transfers (SILVA, 2015).

The different types of cancer correspond to the various types of cells that start in the epithelium of our body, and these cells are called carcinomas. They start in the connective tissue bones, muscles, cartilage called carcomo (BRASIL, 2021). Another difference is the appearance of cancer and the type of cancer where cell proliferation occurs and has the ability to replicate in adjacent tissues and organs, called metastasis (CRISTO & ARAUJO, 2011).

Various cancer treatments go a long way toward treating and even curing. for various treatment modalities. Non-descriptive chemotherapy used before surgery can reduce tumor size, increase chemotherapy and be used to support the surgical procedure to eliminate the possibility of metastases in patients with the disease (FERNANDA et al, 2014).

Chemotherapy in pill capsules, a liquid that can be seen in the daily lives of nursing professionals who care for cancer patients undergoing chemotherapy, can observe

different effects of chemotherapy treatment. Along with diarrhea and vomiting, gastrointestinal disease is one of the most reluctant diseases, the consequence of which is malnutrition, which can lead to multiple metabolic imbalances in patients (KARKOW, 2015).

Health professionals play an important role in monitoring to mitigate side effects and take positive actions through the physical and emotional adjustment of patients undergoing chemotherapy (LEAL, 2016). The role of nurses in these patients' camps is important in the development of preventive measures and actions to reduce the negative effects of chemotherapy (LEAL, 2016).

Implementation of nursing in the systematic organization I mentioned. Hospitalization determines the impasse caused by the administration of chemotherapy. Faced with the various symptoms that chemotherapy brings to the lives of chemotherapy patients, nurses have the responsibility to provide chemotherapy patients with quality of life before and after chemotherapy. better (LEAL, 2016).

The process of adaptation and coping with the new reality changes the daily life and the family environment, so it is essential to understand and work on the changes caused to the diagnosed so that it is possible to understand the situation. Family support is even more important in this situation, and should be a source of strength to overcome it. However, there are still problematic effects and then the

mental stabilization capacity, especially for spouses (PEREIRA et al., 2017).

How should the health professional camp for elderly cancer patients be carried out? The general objective was to provide a review of the literature on the role of nurses in the care of elderly patients with cancer. The general objective was to provide a review of the literature on the role of nurses in the care of elderly patients with cancer.

As the elderly population increases and new causes of cancer are discovered in this condition, there is a need for research and scientific production of materials to improve the techniques used by nursing professionals to provide a better quality of life. Patients receiving chemotherapy (ZUCOLO, 2014).

Chemotherapy associated with elderly patients has shown good results for the effective cure of several types of cancer, but it has more adverse side effects in patients over 60 years of age who, in addition to being limited by age, have already experienced the effects of chemotherapy (LEAL, 2016).

## II. MATERIALS AND METHODS

This is a qualitative study through a comprehensive literature review. This type of scrutiny makes it possible to analyze scientific research in a systematic and broad way, facilitating the characterization and dissemination of the resulting knowledge. Its purpose is to collect and synthesize research results on a specific topic or issue in a systematic and orderly manner.

The following inclusion criteria were used: articles available in full, which understood the objectives of the study, published in the time frame from 2010 to 2021, in scientific journals and online libraries, in Portuguese, English and Spanish. The exclusion criteria were research published in congresses, blogs, forums or that did not meet the objectives or period of the study. To this end, 14 scientific articles related to the subject were analyzed, publications between the years 2010 and 2021 in databases such as: National Library of Medicine (PUBMED), Literature, Latin American and Caribbean in Health Sciences (LILACS), Library Virtual Health Department of the Ministry of Health (BVS), Scientific Electronic Library Online (SciELO), Brazilian Journal of Nursing (REBEN) and Google Scholar.

The bibliographic research had as a problem question: How should the health professional make the camp for the elderly cancer patient? Articles that sought to explain the subject were selected, which were in Portuguese, English and Spanish.

The organization of this review took place between December 2021 and February 2022, providing researchers with guidance relevant to the topics in question so that they can develop hypotheses for children who seek solutions to common problems associated with care. provided in a previous study.

This study did not need to be submitted to the Research Ethics Committee (CEP), as it was a study based on a literature review and all study data were analyzed and written in Microsoft Word®.

## III. LITERATURE REVIEW

A hallmark of cancer cells and their ability to spread to other organs, in a process called metastasis, categorizes different types of cancer based on the types of cells and organs in which some of the more common types of cancer are developing. Common are: lung, breast, colorectal, stomach and prostate, and the ones that leave more survivors are: breast, prostate, colorectal and uterus, but they can also develop in other organs such as: Anus; Bladder; Mouth and oropharynx; Colorectal; Head and neck; Nasal Cavity; Oral Cavity and Oropharynx; Cervix of the Uterus; Endometrium; Esophagus; Stomach; Liver; Gastric; Adrenal Gland; Salivary glands; Larynx and Hypopharynx; Leukemia; Mama; Melanoma; Multiple myeloma; Nasopharynx; Neuroblastoma; Eye; Ovary; Osteosarcoma; pancreas; Skin; Prostate; Lung; Kidney; Uterine Sarcoma; Testicle; Thymus; Thyroid; Bone Tumors; Vagina; Vesicle; Biliary Pathway; Vulva. Among other numerous types of cancer (CANDICO, 2016).

The risk factors for the development of certain types of cancer are mainly (about 80%) directly related to genetic factors, but these factors are easily potentiated when related to increased environmental pollution, physical inactivity and smoking, in addition to people's aging. The world population, a fact that has led to an increase in cancer cases in the last decade (ZUCOLO, 2014).

Even with advances in medicine and pharmaceutical science in the development of new drugs and alternative treatments that have improved the recovery rates of cancer patients over the years, cancer still causes a large number of deaths each year, making it the second cause of death in Brazil, with approximately 190,000 deaths per year (BRASIL, 2017).

As life expectancy has increased over the years, the number of cancer cases is increasing every year, which requires qualified professionals to identify early and assist during treatment, 70% of cancer diagnoses in Brazil are made in people. cancer cases in people over 60 years of age, concerns the fact that 60% of cases are diagnosed in



more than 70% of the population, reinforcing the importance of adequate treatment (INCA, 2021).

According to the World Health Organization, a quarter of the world's men aged between 60 and 79 have developed or will develop some type of cancer among women of the same age group, and the incidence is even higher, with one in three cancers being the second leading cause of death worldwide, causing 9.6 million deaths worldwide in 2018 Behavioral food risk High body mass index Low fruit and vegetable intake of cancer deaths are caused by infection (INCA, 2020) ).

In 2020, the National Cancer Institute estimated that there were 449,090 new cases of non-melanoma skin tumors in men and women. Estimates also point to the possibility of 625 thousand new cases of cancer across the country in the triennium 2020-2022, and excluding cases of non-melanoma skin cancer, the number remains high, reaching 450 thousand (INCA, 2020) .

In the Amazon, the estimated rate is 23.57, or 35 cases per 100,000 women. In Manaus, capital of the region, where the majority of care takes place, the indicator is 53 cases. (Inca 2020). The cellular changes that lead to cervical cancer are easy to detect during a preventive exam: the Pap smear. Currently, the Unified Health System (SUS) makes the HPV vaccine available free of charge for girls aged 11 to 14 years. Vaccination is the most effective measure to prevent HPV (INCA 2020).

The state of Rondônia implemented 0 RHC in the Basic Hospital and in the Cacoal Hospital between 2012 and 2013, but the Epidemiological Surveillance of the State of Cancer of the National Health Service (Agevisa) explained that it was an agreement between the three parties. Cancer is monitored in Brazilian states through disease registries. Under the agreement, the Hospital Cancer Registry (RHC) will be implemented in all hospital units that treat the disease (AGEVISA-RO, 2020).

The number of cancer diagnoses in Cacoal is 7.95 per 1000 (one thousand) inhabitants. The largest numbers are women and people over 60 with fair skin. The most detected type was breast cancer, followed by uterine cancer in women and prostate cancer in men. In the treatment of these patients, the combination of chemotherapy and radiotherapy is more recommended (FARIA et al, 2020).

A diagnosis of cancer, like the revelation of any deadly disease, can change families more or less. This is because the family represents a powerful circle in which everyone becomes more connected, whether with the patient or the disease, and the exchange of information and feelings that affect connection and personal bonds. Therefore, while family support is one of the patient's main resources for

coping with the disease, family members are also affected when dealing with the emotional needs of the affected members. It is in this sense that cancer can be considered a family disease.

The earlier the cancer is detected and treated, the greater the chance of cure and the better the patient's quality of life. Actions as part of early detection. Note that the goal is to detect precancerous or cancerous lesions while they are still in the organ of origin and before they invade surrounding tissue or other organs. Two strategies used in early detection: early diagnosis, screening. The objective of early diagnosis is to detect the disease as quickly as possible through the symptoms or clinical signs present in the patient.

Chemotherapy is the most common form of cancer treatment. About 60% to 70% of patients require this therapy, which uses chemicals alone or in combination to treat malignancies that may or may not be related to other modalities. Treatment options are based on the patient's tumor type, biological behavior, location, extent of disease, age, and general condition. Currently, this treatment modality is possible thanks to the use of continuous infusion devices (SIQUEIRA et al, 2013).

Continuous infusion devices are unidirectional elastomer pumps. Its main components are: unidirectional elastic balloon, blocker, tube, protective cap, threaded joint and end cap. Can be used for intravenous, epidural or subcutaneous infusions for 12 hours to 7 days. Among its advantages we can mention mobility, ease of occlusion and the fact that the infusion parameters cannot be changed by the user. The disadvantage is the low precision of the equipment and the lack of consistency in the infusion time, that is, the reliability of the drug infusion rate being the same throughout the period is not high.

Currently, chemotherapy is the treatment with the highest curative rate for a variety of tumors (including the most advanced tumors), and it is also what can improve the survival rate of patients with AC. It involves the use of chemical agents that interfere with the processes of cell growth and division, either alone (single chemotherapy) or in combination (multiple chemotherapy), to eliminate tumor cells from the body (OLIVEIRA, 2015).

In the case of treatment, radiotherapy, chemotherapy and surgery, the diagnosis is guided and selected according to the stage of the disease, but all provoke reactions. Chemotherapy, which has the ability to eliminate cancer cells, causes multiple responses due to its mode of action and can have multiple effects on the health of patients receiving chemotherapy, especially the elderly (CIRILO, et al., 2016).

It is also noteworthy that staying at home and living with family members can minimize the discomfort of the disease and treatment, as prolonged or frequent hospitalizations, in addition to extreme discomfort and exhaustion, can pose a threat to these individuals (SIQUEIRA et al., 2013).

Another possible classification type is neoadjuvant chemotherapy, administered before surgery to assess antitumor response and tumor reduction, and adjuvant chemotherapy, administered after surgery to eradicate micrometastases. The routes of administration of chemotherapy are oral, intramuscular, subcutaneous, intravenous (most commonly), intraarterial, intrathecal, intraperitoneal, intrapleural, vesical access and topical (OLIVEIRA, 2015).

For cancer patients, the presence of cancer has a dramatic impact on their daily life, leading to profound changes in their usual lifestyle, in addition to affecting the ability and ability to carry out activities of daily living (SIQUEIRA, 2013).

The adverse effects of chemotherapy are due to the fact that it is not specialized, that is, they are drugs that do not only affect tumor cells. It acts on rapidly dividing cells, mainly hematopoietic tissues, hair follicles, germ cells, lining epithelium of the gastrointestinal tract, among other organs, and may cause side effects (OLIVEIRA, 2015).

At this moment, nurses play an important role in cancer patient care, because by monitoring, directing and implementing actions, they can promote awareness and response to the disease and its treatment, due to a better understanding of their pathology, presentation of effects, treatment, consequences and chances of cure, enabling patients to find more effective ways to tolerate and face all stages of this terrible disease (SIQUEIRA et al., 2013).

Hospitalization can lead to major changes in the patient's lifestyle, distancing him from his social life and personal objects, in addition to increasing the risk of hospital infections. In addition, hospitalization is difficult because it limits the number and rotation of visitors, which makes patients uncomfortable and unpleasant (SIQUEIRA et al., 2013).

It is necessary to become a trained professional, competent in the activities that he performs in order to be able to safely guide towards a humanized and individualized care, go beyond his scientific knowledge and build a willingness on the part of the nurse to listen to the relationship with the patient and tell him about it. your treatment. Effective communication, which provides clear and objective information, offers better options and solutions, is another way for patients to address concerns

about the disease and treatment, being essential for quality care (SIQUEIRA et al., 2013).

The treatment brings several side effects to the patient's life, which the nurse must carefully observe, and the entire team is involved in the treatment process. The cancer patient undergoing chemotherapy has many side effects that affect taxes, emotions and physiology. . You will say loss of appetite and dizziness (CUBERTO &, GIGLIO, 2014).

Faced with the impact of a diagnosis and its consequences, the psychologist's role in oncology proposes psychosocial and psychotherapeutic support and shows the potential to help improve the coping and quality of life of patients and their families (SCANNAVINO et al., 2013).

Knowing how to guide and identify doubts and anxieties is fundamental for the performance of the nursing professional. Knowledge added to effectiveness, communication, sincerity and empathy are constructive elements of care that will influence the development of care provided to cancer patients (SIQUEIRA et al., 2013).

The main role of the pharmacist in the oncology pharmacy is to help improve the adequacy of treatment, increase its effectiveness and reduce the incidence of adverse effects and medication errors. The community health work environment is considered less hierarchical than the hospital environment, where many nurses are considered to have greater autonomy and opportunities to use their initiative to develop care. The family is a fundamental factor in coping with the disease and, in addition to maintaining the inherent spirituality and ensuring forms of recreation, it can also serve as a source of support and security. Women with family support are better able to overcome problems, and they use family support as an incentive to seek quick medical care and the possibility of treatment (PANOBIANCO et al., 2012).

Sometimes, patients can be unable to participate in the daily activities that I practice for a long time, leaving them feeling unable to know that, due to this cancer, they will no longer be able to carry out their daily activities and will undergo changes in their living habits. The nurse is responsible for meeting the physical and emotional needs of the patient, such as hygiene and food care, guidance on medication and monitoring of vital signs (TAMBORELLIL et al., 2010).

In the treatment of elderly patients, the tendency of the elderly to respond more strongly to the use of medications should be noted. Nurses must know the pharmacokinetics and pharmacodynamics of medications used for proper administration and be able to identify side effects. By understanding the ingredients of the drugs I use to treat patients, nurses can determine dosage adjustments and

what happens to girls during treatment (FERNANDO et al., 2016).

The personal well-being of patients is a right that must be respected by any age group. Caring is a form of interaction that involves dedication, interest, participation and responsibility. In the care team, care can be demonstrated in different ways, such as gestures of affection, posture, look and touch, empathy with the patient, knowing how to listen to the patient's reports of fears regarding the diagnosis of cancer or uncertainties. Including the treatment modality (SIQUERA et al., 2014).

Nursing professionals and underlying cancer patient camps From prevention, diagnosis, treatment and rehabilitation, the nurse must have warm company and pass on the patient's trust and awareness of the teeth that treatments and procedures will be carried out in the best possible way. Help cure or reduce pain in the home of terminally ill patients (LEAL, 2016).

Due to industrialization and the age transition from the young to the elderly population, the Brazilian health service has recognized cancer as a serious public health problem, not only at the national level, but mainly in developed countries. More than 6 billion people die each year in this country, which has one of the highest cancer rates, but is starting to change slightly in developing countries as cancer rates increase (CONCEIÇÃO et al., 2012).

The patient and his family need to remain strong, especially in solidarity. It is important to understand the realities of life of the cancer patient and their family, the patient's history and role within the family, both financially and personally, living conditions, work and even the patient's beliefs to be able to help and be better and ways to provide support (MUNIZ et al., 2012).

Chemotherapy, the mainstay of cancer treatment, has high cure rates, although its side effects on patients often leave the elderly vulnerable.

#### IV. FINAL CONSIDERATIONS

Health professionals, especially those with high exposure to nurses, are essential in any scenario, but nurses play a fundamental role in cancer patients, and even more so in older patients, especially when they receive in the process. Considering that the elderly tend to see the situation as the end, they end up refusing treatment and, most of the time, they do not bother to seek help because they feel that there is no solution.

The most fundamental role of nurses caring for elderly cancer patients is to use empathy and understanding, as

well as to minimize fear, distress, anxiety, and other complications of old age.

Considering that nurses are the most active professionals in primary care, the ideal is to always seek care in a totalitarian way, with attention to the details of each patient being essential. Although the present study is a real contributor, there is a need for more research covering other aspects of the topic, such as interviews with patients and professionals in the region, public and private hospitals, care in primary care networks, health, so that it can complement this research and provide a complete source of information for anyone who wants to understand the subject.

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## Palliative Care in Amyotrophic Lateral Sclerosis: A View of Comprehensive Care

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**Keywords—** *Amyotrophic lateral sclerosis.  
Palliative care. Comprehensive care.*

**Abstract—** *Objective: Discuss through a literature review about the need for palliative care for patients with amyotrophic lateral sclerosis (ALS). Method: An integrative literature review was adopted, since it contributes to the process of systematization and analysis of results, aiming at the understanding of a certain topic, based on other independent studies. This is a study with a qualitative approach, to identify productions on the topic of palliative care in patients with ALS. Results: The involvement of palliative care clinics composed of doctors, nurses, physiotherapists, speech therapists, psychologists and nutritionists promote programmed and continuous actions that can increase survival and improve comfort at the end of life in ALS. The integration of palliative care into health systems benefits the user by increasing access to this care and can also strengthen health systems, as it results in benefits that spread and improve the quality of care. Final Considerations: The care of ALS patients is complex, however, as the disease burden increases, access to these specialist clinics can become difficult or impossible for the patient. Understanding the current multidisciplinary team paradigm to include collaborations with local providers, including palliative care physicians and allied healthcare providers, can ensure that patient needs are met throughout the course of illness, especially during terminal illness.*

## I. INTRODUCTION

Amyotrophic lateral sclerosis (ALS) is a degenerative neuronal disease with a highly predictable clinical course, progressive and relentless in nature. Due to its clinical characteristics, ALS represents a paradigm for palliative care in neurological diseases, so that it should start at the moment or soon after diagnosis.[1]

ALS also affects the muscles used for breathing, speech, and swallowing, which can cause physical discomfort and emotional pain. Most people with the disease worry about how this loss will make them dependent on others for even the most common tasks, such as bathing, dressing or eating.[2]

Care is intensified when symptoms gradually increase, associated with disease progression. End-of-life care for all disorders is associated with increased use of health services. Palliative services are associated with fewer hospital and intensive care unit (ICU) visits and more cost-effective care.[3]

Palliative care (PC) consists of assistance, promoted by a multidisciplinary team, which aims to improve the quality of life of the patient and their family members of a disease that threatens the continuity of their life, through the prevention and relief of suffering, early identification, relentless assessment and treatment of pain.[4]

The objective of this research was to discuss, through a literature review, about the need for palliative care for patients with ALS.

## II. METHOD

This is a study with a qualitative approach, to identify productions on the topic of palliative care in patients with ALS. An integrative literature review was adopted, since it contributes to the process of systematization and analysis of results, aiming at the understanding of a certain topic, based on other independent studies.

The integrative literature review proposes the establishment of well-defined criteria for data collection, analysis and presentation of results, from the beginning of the study, based on a previously elaborated and validated research protocol. [5] The focus in the elaboration of the research was to understand the findings on palliative care for patients with ALS, and to highlight which care would be important, with a focus on hospital care.

For that, the six steps indicated for the constitution of the integrative literature review were adopted: 1) selection of the research question; 2) definition of

inclusion criteria for studies and sample selection; 3) representation of the selected studies in table format, considering all common characteristics; 4) critical analysis of the findings, identifying differences and conflicts; 5) interpretation of results and 6) clearly reporting the evidence found.

The study identification and selection strategy was the search for publications indexed in the Medical Literature and Retrieval System on Line (MEDLINE), Latin American and Caribbean Health Sciences (LILACS) and Scientific Electronic Library Online (SciELO) databases, in April 2021.

The following criteria were adopted for the selection of articles: all article categories (original, literature review, reflection, update, experience report, etc.); articles with abstracts and full texts available for analysis; those published in Portuguese and English, between 2017 and 2021, and articles that contained in their titles and/or abstracts the following descriptors in health sciences (DeCS): Amyotrophic Lateral Sclerosis; Palliative care; Comprehensive care. The resource used in the research was the expression “exact term”, associated with specific descriptors.

The exclusion criterion for the articles was: studies that did not meet the aforementioned inclusion criteria. In the search in the databases, 263 articles were found talking about Amyotrophic Lateral Sclerosis, related to palliative care were only 32, of which each abstract/article was carefully read, highlighting those that responded to the objective proposed by this study, the in order to organize the findings.

Following the inclusion criteria, 16 studies were selected for analysis, which are referenced in this text. A bibliometric analysis was carried out to characterize the selected studies. Subsequently, the concepts addressed in each article and of interest to the researchers were extracted.

## III. RESULTS AND DISCUSSION

In 2014, the World Health Organization (WHO) published the Global Atlas of Palliative Care, where it presented the results of its survey on the development of palliative care around the world. Brazil received a 3 A rating, which means that palliative care is limited in terms of networking, with funding sources heavily dependent on donations; limited availability of morphine; and a small number of palliative care services compared to the size of the population.[6]

According to The Economist (2017) who evaluated the quality of death in 80 countries. Assessed availability of

access to opioids, existence of specific public health policies on palliative care and access to palliative care in health services. Brazil ranked 42nd, a ranking worse than Chile (27th), Costa Rica (29th), Panama (31st), Argentina (32nd), Uruguay (39th), South Africa (34th), Uganda (35th), Mongolia (28th) or Malaysia (38th). [7]

In 2017 the Lancet Commission on Access to Opioids and Palliative Care published results of their worldwide survey, the results were frightening. It has been shown that Brazil suffers from a shortage of opioids. The amount of opioids prescribed in the country is insufficient to provide adequate pain relief that seriously ill patients living in the country have. The common conclusion among all these studies is the evidence that in Brazil it is common for people with serious illnesses to often live with uncontrolled pain and without receiving adequate palliative care. [8]

ALS is accompanied by progressive muscle weakness, accompanied by muscle atrophy, fasciculations, muscle cramps, and slowness of movement with muscle stiffness.[9] The onset of muscle weakness in ALS is usually focal and typically spreads to adjacent body regions. This pattern is compatible with the spread of disease pathology within the motor system, with neuroanatomical spread within the spinal cord and motor cortex segments.[1]

Motor neurons run from the brain to the spinal cord and from the spinal cord to muscles throughout the body, the progressive degeneration of motor neurons in ALS eventually leads to their death. When motor neurons die, the brain's ability to initiate and control muscle movement is lost, with voluntary muscle action progressively affected, people may lose the ability to speak, eat, move, and breathe. [10]

The response to their needs is usually delayed and largely based on institutional palliative care focused on cancer. There is a great need to identify these patients and integrate an early palliative approach according to their individual needs in all settings, as suggested by the WHO.[11]

The involvement of palliative care clinics composed of doctors, nurses, physiotherapists, speech therapists, psychologists and nutritionists promote programmed and continuous actions that can increase survival and improve comfort at the end of life in ALS. The integration of PC into health systems benefits the user by increasing access to PC and can also strengthen health systems, by strengthening and improving the quality of care. [12]

Patients with ALS have a some advantages in the decentralized PC service of hospitals should be highlighted: early dehospitalization; cost reduction;

training family members with programs that facilitate alternative non-verbal communication; management of total or partial oral supply or suspension of food, maintaining oral pleasure; possibility of an interdisciplinary team trained to monitor the clinical condition of patients; respiratory comfort with adequate ventilation patterns; monitoring of nutritional and metabolic status.[13]

In some patients, muscle weakness is preceded by a period when fasciculations, muscle cramps, or slight weight loss have been observed. The progressive and relentless nature of amyotrophic lateral sclerosis (ALS) culminating in respiratory failure makes end-of-life care planning and implementation an integral component of caring for ALS patients.[13]

Traditional models of palliative care do not sufficiently address the specific needs of patients and families living with a neurological diagnosis. In addition, palliative physicians who are extensively trained in internal medicine may be less comfortable with neurological diseases than with cancer or other medical diagnoses.[13]

Patients with limiting neurological diseases usually have a long and variable disease progression, punctuated by cognitive impairment, behavioral and communication problems, in addition to motor symptoms.[9] This trajectory differs from the sharp decline seen in many cancer patients. Palliative care services are increasingly recognizing the needs of cancer-free patients, particularly in rapidly progressing neurological conditions such as motor neuron diseases, however this growth is gradual.[11]

Differences between neurology and other patients include symptom profiles, psychosocial issues, caregiver needs, and effects on spiritual well-being. As examples, patients with motor neuron disease experience more demoralization, hopelessness, and suicidal ideation than patients with metastatic cancer, patients with brain cancer have distinct symptom profiles, including more cognitive problems, seizures, and communication deficits than patients with brain cancer living with other types of cancer; and Huntington's disease patients have distinct social work needs as a result of combined behavioral, psychiatric, movement, and cognitive issues.[14]

Physical and cognitive impairments associated with neurological diseases also contribute to the feeling of being "useless" or a "burden" and may contribute to higher rates of demoralization.[22] Neurological diseases are associated with caregiver suffering and reduced quality of life related to care, well-being, depression and demoralization.[15]

The concept of adequate neuropalliative care is defined by Sutton (2008) as "a holistic approach to the care of

neurological patients with significant disabilities, complex needs and a potentially shortened life expectancy. It is patient-centered and involves diagnosing clinical problems at all stages, rehabilitation to maintain function, coordination of care, and adequate palliation to alleviate symptoms.”[16]

For neurological patients, the most appropriate forms seem to be the so-called “early” palliative care and the “dynamic model” of palliative care.[13] Early palliative care does not exclude the simultaneity of curative care, the intensity of palliative care services gradually increasing as the disease progresses.[17]

In the dynamic model, specialized palliative care services are provided based on trigger points, that is, in intermittent periods according to the needs of patients. [18] The objective of palliative care at all stages of the disease should be to achieve the ideal quality of life for patients and their families.[19]

On the other hand, specialized palliative care must be provided in the form of complex interventions that positively impact the quality of life of patients and their families, reduce the burden of physical symptoms and have a positive effect on psychosocial and spiritual issues, individual preference for care, and the quality of death and dying.[20] The analysis of patients' subjective perception of the impact of the disease and treatment on activities of daily living, self-care capacity, emotional experiences, social relationships and level of anxiety, tension and depression is very important for the evaluation of the quality of care provided to patients with ALS.[21]

Based on a systematic review and meta-analysis, the PC intervention is associated with improved quality of life for patients with life-limiting disease and an attenuated symptom burden. However, they found no connection between palliative care and survival. Few studies have been published analyzing the positive effects of neuropalliative care on the quality of life of ALS patients and their family caregivers, or on satisfaction with the care provided.[22]

Several studies have indicated an improvement in quality of life and a reduction in pain, dyspnea, sleep disturbances and intestinal symptoms, after the application of palliative care in patients with amyotrophic lateral sclerosis, multiple sclerosis, Parkinson's disease, neurodegenerative diseases and, in addition, a reduced burden for family caregivers.[20]

A randomized trial confirmed the financial efficiency of early palliative care in patients with multiple sclerosis.[23] Additional research to focus are recommend on the effect of complex, specialized palliative care

interventions on all aspects of the quality of life of ALS patients.[24]

#### IV. FINAL CONSIDERATIONS

Palliative care are practices aimed at the final period of life of patients outside of therapeutic cure procedures, such practices seek to control the physical and psychological signs and symptoms of the advanced stage of ALS, in addition to improving the quality of life.

The care of ALS patients is complex, however, as the disease burden increases, access to these specialist clinics can become difficult or impossible for the patient. Extending the current multidisciplinary team paradigm to include collaborations with local providers, including local palliative care physicians and allied healthcare providers, can ensure that patient needs are met throughout the course of illness, especially during terminal illness.

Much can be done to mitigate the disease burden of ALS patients through the use of palliative interventions. There is considerable evidence that PC intervention improves the quality of life of patients and caregivers. Although new treatments for ALS are being developed, they are not curative and only offer the potential to slow its progression.

Therefore, both the multidisciplinary palliative care team and the neurology team are essential to provide a high standard of care and allow the maintenance of quality of life.

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# The Teacher's Knowledge/Doing About Active methodologies for meaningful Learning in Higher Education: An Integrative Review

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**Keywords—** Active learning methodologies. Meaningful Learning. Higher education.

**Abstract—** Objective: Map the scientific evidence about the knowledge and actions of university professors about active methodologies and describe the perception and opinion about the modes of organization, methodological approaches and evaluation systems that define the teaching-learning process. Method: This is an integrative literature review, in which 11 articles were selected from the Google Scholar, SciELO and PubMed databases, by fulfilling the requirements established in the eligibility criteria and answering the research question. Results: The findings were categorized into 1) Benefits of applying active methodologies in higher education; 2) Knowledge of professors working in higher education about active methodologies; 3) Practices of active faculty in higher education on active methodology. Final Considerations: Promoting active learning is not an easy task to be achieved and teachers play a fundamental role in its implementation process.

## I. INTRODUCTION

Teaching and learning practices in higher education are undergoing a series of changes that have significant implications for the nature of students' learning experience. The traditional approach to teaching in Brazil, as in many parts of the world, involved the unilateral transmission from teacher to students. In higher education, appeals have been made for active learning experiences that place the student at the center of learning, rather than accepting students as passive listeners. [1]

Generally speaking, a teaching situation corresponds to the moment when one person intentionally helps another to learn something. However, individual knowledge is not a concrete and directly observable object, but, above all, a set of mental representations built from the interpretive dynamics that the subject of knowledge establishes with the objects of the world he perceives. Thus, the act of teaching and learning is mediated by different representations of the same knowledge: that of the teacher, that of the student and that of the teaching material. [2]

In the meantime, learning, in this dynamic, corresponds to a continuous, personal, intentional process, as it is up to the student to substantively relate the new information with the relevant ideas existing in their cognitive structure, active (because it requires mental activity), dynamic, recursive, of interaction (between information and prior knowledge) and interactive (because it establishes relationships between subjects), which generates an always provisional product characterized by a particular knowledge produced in a given moment and context. [3]

From this perspective, Meaningful Learning, according to David Ausubel [4], is a promising strategy in a formal teaching situation, which consists of the non-arbitrary and non-literal interaction of new knowledge with relevant prior knowledge. Thus, from successive interactions, the object of knowledge progressively acquires new meanings, becomes richer, more refined, more differentiated and is capable of serving as an anchor for new significant learning.

The central point of reflection in Ausubel's Theory of Meaningful Learning (TML) is that, among all the factors that influence learning, the most important is what the student knows in advance, which is considered the starting point. [5]

In this context, the so-called active teaching methodologies arise, consisting of a change in the learning paradigm and in the relationship between teacher and student. The student then becomes the protagonist of the teaching process, while the educator assumes the role of an advisor, opening space for the interaction and participation of students in the construction of knowledge. [6]

In 2012, the European Space for Higher Education highlighted the importance of students thinking critically as part of genuine student-centred learning, as seen in the curricula of many universities. That critical thinking is a reflective activity that leads to action and that, in order to develop it, students must think about what they think. [7]

Universities should encourage how to think, not what to think. Reading and reflecting from different sources can overcome the lack of experience at graduation. Thinking critically is a process and its acquisition requires time. [8]

In this process, university professors must be aware of the need for a transformation to adapt their teaching methodologies to the learning of their students, as their way of thinking can generate fixed routines in their teaching practices. That is, the teacher must also reflect on their practices and introduce different and varied methodologies. [9]

Thus, the objective of this study is to map the scientific evidence about the knowledge and actions of university professors about active methodologies and to describe the perception and opinion about the modes of organization, methodological approaches and evaluation systems that define the process of teaching-learning.

## II. METHOD

This is an integrative literature review, which includes the analysis of current research results that can support the understanding of the current scenario of active teaching methodologies from the perspective of knowledge (knowing) and practices (doing) of active teachers in higher education.

It can then be said that active methodologies contribute to the development of skills and abilities as they provide students with the role of protagonists in the learning process. Therefore, teaching-learning methods should be valued as essential elements in the construction of training through competences. [10] In this context, the integrative review is a method that provides the integration of knowledge and the applicability of important research results in practice, allowing to gather and summarize several published studies, as well as bringing conclusions about the topic addressed in the study. [11]

Seven steps were used for the development of this integrative review, namely: 1) identification of the theme and selection of the hypothesis or research question for the elaboration of the integrative review; 2) establishment of inclusion and exclusion criteria for studies/sampling or literature search; 3) definition of information to be extracted from selected studies/categorization of studies; 4) evaluation of the studies included in the integrative review; 5) interpretation of results and 6) presentation of the review/synthesis of knowledge. [12]

To answer the objective of the work, the following research question was developed: what has been researched and published in scientific circles in the last ten years, about the knowledge and actions of higher education teachers about active teaching methodologies for a meaningful learning?

The inclusion criteria established were: qualitative or quantitative research, available online, in the format of articles, in English and Portuguese, published in the last ten years (2012 to 2021), which focuses on the analysis of perception and implementation of active methodologies in higher education. Articles not related to the proposed theme, other types of texts such as

dissertations, theses, etc., as well as repeated articles in the consulted databases were excluded.

Initially, 88 articles were found in the Google Scholar (28), SciELO (03) and Pubmed (57) databases, using the keywords "Active methodologies", "Meaningful learning", "Higher education", by use of Boolean operators. After applying the filter "year of publication" and reading the abstracts, 11 articles were selected that met the requirements established in the eligibility criteria and were in accordance with the

objectives proposed by this work.

### III. RESULTS AND DISCUSSION

In this narrative review, 11 original scientific articles were selected that strictly met the previously established criteria for sample selection and showed similarities with the object of study of this research, as shown in Table 1:

Table 1: Distribution of studies.

STUDY	TITLE	AUTHOR/YEAR	OBJECTIVE	MAIN RESULTS
1	Percepção das metodologias ativas por professores que atuam no Estado de Minas Gerais, Brasil.	Nascimento, Mesquita e Vianna (2021).	Evaluate the perception of active methodologies by teachers who work in basic and higher education in the State of Minas Gerais.	Although 79.2% of respondents did not receive training during graduation, most consider their inclusion relevant, reflecting the need to modernize the curricula.
2	Methodologies for teaching-learning critical thinking in higher education: The teacher's view.	Bezanilla <i>et al.</i> (2019).	Review the literature focusing on methodologies used to teach critical thinking in higher education and not on assessment or the concept of critical thinking.	The results seem to indicate that teachers use and consider as most effective mainly three different methodologies: oral and written reflection and argumentation; reading, analysis and synthesis of resources; and case studies, regardless of their concept of critical thinking, although some other trends are observed, such as critical thinking methodologies and concepts.
3	Percepção dos docentes sobre o uso de metodologias ativas de aprendizagem em um curso de sistemas de informação.	Pessoa <i>et al.</i> , (2019).	Conduct a survey with the teachers of the Bachelor of Information System (BSI) course, about the use of active methodologies, how they are applied in the classroom and how assessments intermediated by active methodologies are carried out	The results showed that teachers have difficulties with the application of active methodologies, as well as showing a resistant attitude towards the change to this new teaching model.

4	Metodologias ativas de ensino e aprendizagem: a percepção de professores do Curso de Nutrição de uma Instituição de Ensino Superior na Amazônia Ocidental.	Nogueira (2017).	To investigate the perceptions and practices of teachers about Active Methodologies and their role in the teaching and learning process in a Nutrition Course at a private Higher Education Institution in Porto Velho-RO.	It was noted that some teachers were a little reticent to change, pointing out some difficulties in the use of Active Methodologies in the Nutrition Course of the studied institution, however, in a still quite empirical way, it was noticed that they have performed attempts to use innovative teaching strategies in their classes, despite having declared that they do not have sufficient pedagogical preparation to understand more clearly the elements that involve pedagogical practices and their epistemological bases.
5	Percepção do docente e discente sobre o uso de metodologias ativas de aprendizagem no ensino medico na Universidade São Francisco.	Plantier; Costa e Garcia (2020).	Evaluate the level of perception of professors and students of the Medicine Course at Universidade São Francisco regarding the development of Active Methodologies.	From the evaluations and opinions, it was possible to assess the familiarity of professors and students, the contribution of Active Methodologies in the critical and reflective formation of the student, their role in the development of interdisciplinarity and interpersonal and interprofessional relationships.
6	Teachers' perceptions of aspects affecting seminar learning: a qualitative study.	Spruijt <i>et al.</i> (2013).	Qualitatively explore teachers' opinions on aspects that affect seminary learning.	Teachers identified seven key aspects that affect seminary learning: the seminary teacher, students, preparation, group functioning, seminar objectives and content, course coherence, schedule, and facilities.

7	Faculty and second-year medical student perceptions of active learning in an integrated curriculum.	Tsang e Harris (2016).	To analyze the perceptions of students and teachers about active learning in an integrated medical curriculum in the second year, where students were exposed to multiple educational pedagogies.	Teachers felt that active and collaborative learning was more effective. Teachers felt that lack of curriculum time and preparation time were barriers for the faculty.
8	Behind teaching-learning strategies in physiology: perceptions of students and teachers of Brazilian medical courses.	Nasre-Nasser <i>et al.</i> (2021).	To analyze the perceptions of medical students and professors about the teaching-learning strategies used in physiology in different Brazilian universities, as well as the factors that influence or hinder the learning of this discipline.	Some factors that hinder the teaching-learning process of physiology were identified by the respondents, such as: large amount of information, little time for study outside the classroom, prior knowledge and intrinsic difficulty in the discipline.
9	Metodologias ativas no ensino superior: percepção de docents em uma instituição privada do Distrito Federal.	Azevedo, Pacheco e Santos (2019).	Map the perception of professors at a private college about the use of these methodologies.	The results show that 96% of the participants use active methodologies in their teaching practice.
10	Perception of health-related case studies in the context of introduction to clinical medicine course: students' and teachers' perspective.	Jovanovic <i>et al.</i> , (2020).	To examine the effect of the presentation of clinical cases on short-term memory, as well as on the evaluation of students and professors of this method of teaching and learning in undergraduate medicine.	The presentation of clinical cases has learning potential and facilitates positive interaction between instructors and students and helps students to become reflective and competent physicians.
11	Experiences of medical teachers in flipped learning for medical students: a phenomenological study.	Park; Park e Chae (2018).	Explore the experience of medical professors in the process of adapting the inverted learning method through a phenomenological approach.	Although medical professors did not have quite the same idea about how inverted learning was conducted and implemented, the perception of inverted learning, or difficulties in classroom activities, they were still wondering how they could teach students well. This study can draw more attention to inverted learning and encourage

				educational and institutional supports to improve teaching and learning in medical schools.
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From the analysis of the selected articles, the findings were categorized into: 1) Benefits of applying active methodologies in higher education; 2) Knowledge of professors working in higher education about active methodologies; 3) Practices of active faculty in higher education on active methodology, for better presentation and understanding of results.

**Benefits of applying active methodologies in higher education**

It was found that active methodologies bring direct benefits to students, as they allow the development of their autonomy, thus forming creative, reflective and independent professionals who use the acquired knowledge in a holistic way, minimizing the occurrence of fragmented training. [13]

The implementation of active instruction strategies requires changes in the teacher's logic within the classroom environment. Unlike traditional education that pre-defines the important themes in an organized, systematic and coherent way, so that students can learn; active learning requires that teachers first establish the goals to be achieved and choose one or more appropriate teaching strategies to achieve those goals. [14]

Regarding the use of active methodologies, the results found highlight that they encourage interdisciplinarity, investigation and promote the development of learning tools, as well as group work and student learning. [15]

Similar results, highlighting that the use of active methods promotes students' analysis and reflection, helping students to play an active role in the acquisition of knowledge. The main difficulty in implementing these methods is the high number of students per class, which does not facilitate the development of active methodologies. [16]

**Knowledge of professors working in higher education about active methodologies**

A study proposed to assess the perception of active methodologies by teachers who worked in primary and higher education and the results showed that regarding the knowledge of active methodologies, 82.1% of the teachers knew some methodology, being more familiar with: seminar (57.2%), project/problem-based learning (51%) and inverted classroom (45.7%). Only 20.8% were trained during graduation and only 23.3% received training from

the institution where they work. [17]

The responsibility for curriculum design and development belongs exclusively to the teacher, including the way in which instruction is organized, the choice of content and the teaching methods and assessment procedures. The same is true for knowledge transformation. In this case, reproduction as a product of learning is sought.[18] This model does not seek student involvement in knowledge construction or decision-making about how this knowledge is about student learning, and focuses on competence rather than cooperation, with minimal and unilateral interaction between student and teacher. [15]

Instructions will only occasionally be bidirectional, in order to keep students' attention or ensure understanding of the content covered in order to resolve queries. Typically, these lessons are based on explanation, using lectures, student notes, and memorization so that students can repeat the knowledge later. Students are usually assessed by the traditional exam, the learning-centered model, instead, emphasizes student learning. Knowledge is understood as a personal construction, the result of cooperation between teacher and students. The product of learning must be the exchange of knowledge. [15]

Although the teacher is responsible for curriculum design, this model requires joint work by the teacher and their peers, as well as cooperation with students, of the many broad definitions of active learning, all of which basically involve something more than listen passively. The active participation of the student presupposes the implementation of active methodologies with repercussions both on the educational process and on the mechanisms for evaluating the degree and quality of the acquired learning. [19]

The presence of active methods in university classrooms will be effective as long as the teacher takes into account the student's participation in the organization and proposition of teaching and learning methodologies, as well as assessment methods. In this sense, the better the activity, the greater will be the participation and understanding of students about the content to be learned. Therefore, the teacher must encourage students to seek information, discuss ideas with colleagues, develop new approaches to solving problems and constantly question their own level of understanding. [20]



However, most university professors have little or no preparation for active teaching. Furthermore, active learning instruction is fundamentally different from the traditional lecture approach that most college professors have experienced as students. [21]

### **Practices of professors working in higher education on active methodologies**

The teacher needs to think about the educational process to structure it. However, these professionals generally start their careers as educators, without pedagogical training for teaching, despite having skills in the specialty. [22]

Therefore, the teaching action has been based on the experience of their training process, being a mirror of the teachers themselves, who taught their classes in traditional teaching modalities. [14]

The traditional teaching model gives special importance to the figure of the teacher, in this model, the teacher is the one who knows, and it is their responsibility to transmit this knowledge well, with students having the sole task of reproducing knowledge. [23]

This scenario is consistent with a practice in which teachers teach their classes according to their convictions and repeat models experienced during their training. However, the training of a teacher cannot be restricted to participation in specific courses, and must necessarily include training, supervision and assessment programs that are carried out in an integrated and permanent manner. [9]

A study found that 51.6% of teachers do not receive encouragement to use the methodologies and report as main challenges the lack of training (68%), planning time (48.5%), lack of material (48.5%), application time (42.7%) and student participation (40.2%). Although 79.2% of the research professors did not receive training during their graduation, most consider the inclusion of active methodologies relevant, reflecting the need to modernize the curricula. [17]

Study research that, in the perception of teachers, the main barrier was the lack of time in the curriculum for active learning. [6] Corroborating this, other study concluded that teachers believe they do not have enough time to implement active methodologies with their students. Several professors claim that they do not work exclusively in teaching, having to divide their time between other jobs. [16]

A survey aimed to investigate the perception of teachers about which were the main barriers in the introduction of active methodologies in higher education. Teachers were asked about which points need to be improved to work with more quality in the teaching-

learning process in public universities. Thus, 20% answered the teacher's professionalism as a point to be improved, 20% answered the student's commitment, 20% answered the infrastructure, 30% answered the need for pedagogical planning and 10% did not know how to answer. [19]

The academic performance of students in courses where there was active learning compared to those in passive learning courses (traditional). Their analyzes revealed scores on average 6% higher in active learning course students compared to traditional learning students. In addition, the failure rate of students in traditional classes was 55% higher than that of students in the active methodology. [24]

Most teachers referred as the main strategy used the expository and expository-dialogued class, essentially used by the so-called traditionalist methodologies, totally focused on the content and not on the historical-cultural and social interaction between the subjects of the teaching and learning process. It was noticed that they have attempted to use innovative teaching strategies in their classes, despite having declared a professional training based on traditional education and not having sufficient pedagogical preparation to understand more clearly the elements that involve pedagogical practices and its epistemological bases. [7]

One of the main obstacles faced during the implementation of active methodologies is represented by the resistance of students to be more proactive in their learning. This resistance is generally observed in any approach that is not based on discursive lessons because the active methodologies clearly contrast with the passive listener role that students are used to. [17]

However, there are practical obstacles, as well as obstacles related to the student-teacher binomial, which can limit the use of instructional active learning strategies. Among the practical obstacles are: the limited time available to cover the entire content of the discipline in the classroom, the need for time to develop the strategy before its application, the difficulty of implementing the method in large classes, the teachers' idea about being good speakers themselves and the lack of resources, materials and support equipment. [16]

The most university professors report that they feel ignorance, uncertainty and difficulties in using active methodologies in their teaching practice. In their daily activities, teachers need to think about the educational process to structure it, aiming to provide reflections, skills and actions. This structure is the result of planning, which is directly related to the choice of content, activities, available resources and the methodology to be used. [6]

In contrast, another study shows results that teachers believe they are moving towards a model centered on learning, as teachers believe that the implementation of active methodologies implies new functions in their teaching practice, use assessment systems different from those commonly used. [22]

This conclusion is also highlighted about the students' perception about the usefulness of methodological approaches, which obtained equally positive evaluations for the use of expository methodologies and active learning. Other studies found that students generally had a positive attitude toward active learning, especially when they were told why they were using active techniques. [23]

#### IV. FINAL CONSIDERATIONS

From this review, it was possible to understand about the benefits of using active learning methodologies, as well as the factors involved in the knowledge and actions of higher education teachers.

It is understood that promoting active learning is not an easy task to be achieved and teachers play a fundamental role in its implementation process. The application of active methodologies is not limited to 'experiencing' a differentiated pedagogical activity with students or promoting debates in the classroom. In fact, it means that the effective use of these techniques requires a new philosophical stance from both teacher and student. This posture is essentially different from that observed in traditional classes, which only expect the teacher to "teach" and the students to "learn".

Active learning strategies have been increasingly used in school settings as teachers learn their benefits. Studies have shown that active learning improves understanding and retention of information, and that it is effective in developing high-level cognitive skills such as problem-solving skills and critical thinking.

At the end of a positive active learning experience, students and teachers will benefit from the concepts described in this article. The definition of success in education should not be restricted exclusively to performance appraisals and approval ratings that, in a way, measure the quality of learning in a community, but should also include the meaning of a much broader, more lasting and pleasurable experience, which is portrayed by the real satisfaction in this process, both for the teacher and for the student.

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# Hydrologic data base Management Analysis of Small Islands in the River Region of Maluku

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**Keywords— River region, Rainfall Post, Maluku**

**Abstract—** *In order to optimize and develop water resource management, accurate data is needed for regional development. The data is compiled in the form of a database which is a support for the development of the water resource potential of small islands in Maluku River Region. The purpose of this study is to display a database of infrastructure in the form of Rainfall Posts, Climatology Posts, Water estimation posts, pond distribution data, weir distribution data and water quality in Ambon-Seram, Buru, Kei-Aru Islands and Yamdena-Wetar Islands by using the ArcGIS application. The result of the database is a supporting tool in the managing Hydrology and data at Maluku River Region Hall by providing information in the form of graphical data and distribution map.*

## I. INTRODUCTION

Government institutions and national development organizers institution have carried out development activities throughout Indonesia using maps produced by themselves and from the private parties. This has resulted in the number of maps circulating and used as a basis so that they often become confused in development. To overcome this, firmness is needed in the context of compiling and centralizing mapping systematics. The complexity of water resource problems requires efforts to solve and to anticipate that can not only be done by the government. The view of water resource management areas based on one watershed is not simply accepted by the social environment, because the potential of water resources in a watershed cannot necessarily meet the needs of the people living in the watershed concerned. The concept of integrated management of water resources based on watersheds or river areas is known by the international community as Integrated Water Resources Management (IWRM). Indonesian is one of the countries that has developed the concept of integrated management of water resources based on river areas. In 2015, a Minister of Public Works and Public Housing Number 4 concerning Criteria and Determination of River areas was stipulated. Hydrological

data management includes data collection, processing and publication activities. All these sequences must be implemented properly. Data collection has been carried out regularly by hydrology unit officers and assisted by postal guards who are scattered throughout the working area of the Maluku River Region Hall.

## II. LITERATURE REVIEW

### Hydrological Post

A series of observation posts of hydrological data that can describe the hydrological characteristics of a river area to determine the potential of water resources. Examples of hydrological data are rainfall and discharge data. Rainfall is one of the most important aspects in the field of Meteorology, Climatology and Geophysics. The data obtained from rainfall measurements, can find out weather patterns that occur in an area whose scope is not too broad such as district areas. Rainfall that varies greatly, both in space and time scale, variations in rainfall based on space can be explained in geographical events where rainfall and its frequency Variations in rainfall based on time can be seen from differences in the amount of rainfall and its frequency in each season.

**Irrigation System and Weir**

The irrigation systems include irrigation infrastructure, irrigation water, irrigation management, institutional irrigation management, and human resources. When talking about irrigation, people always think about a rigid infrastructure system and that's not always true. The theory of management, irrigation can be discussed from the point of view of a system because it has elements that are interrelated to achieve one management goal. As a drainage system, the Minister of PUPR Regulation No.30 /PRT/M/2015 concerning the Development and Management of Irrigation Systems considers irrigation to consists of five (5) irrigation pillars, namely: (i) water availability, (ii) infrastructure; (iii) irrigation management; (iv) irrigation institution, and (v) human actors. The five elements must be mutually compatible, related and interrelated so that it can be said that irrigation is a system.

**Pond**

A pond is a water storage structure that is built in a depressed area, usually outside a river. The pond will store water in the rainy season and then the water is used for a village or community group only during the dry season to meet the needs in order of priority: residents, livestock and gardens. The number of needs will determine the height of the pond body, and the tamping capacity of the reservoir. Pond buildings are commonly used in Eastern Indonesia from the island of Bali to Seram island in Maluku Province. The climate in this area is quite dry, where the rainy season generally lasts for 3 to 5 months, while the dry season lasts for 7 to 9 months. For western Indonesia where rainfall is generally high, you can use these reservoir planning guidelines by following the applicable limits or criteria.

**Water Quality**

Water is a natural resource that is needed for the livelihood of many people, even by all living things. Therefore, water resources must be protected so that they can be used properly by humans and other living things. The use of water for various purposes must be done wisely, taking into account current and future generations. Currently, the main problems faced by water resources include the quantity of water that is no longer able to meet the increasing needs and the declining quality of domestic water. River is one of the natural resources. The river is a natural resource that is flowing resources, so the utilization of water upstream will eliminate opportunities downstream. Pollution in the upstream river will cause social costs downstream (*extremality effect*) and conservation in the upstream provides benefits downstream. According to Government Regulation of the Republic of Indonesia No. 82 of 2001 concerning Management Water Quality control of Water Pollution. Water is all water found above and below the

ground surface, including in this sense surface water, groundwater, rainwater and sea water that are utilized on land. Based on the Decree of the Minister of State for the Environment No: 115 of 2003 concerning Guidelines for Determining the status of Water Quality, the definition of Water Quality is the level of water quality conditions that indicates polluted condition or good conditions in a water source within a certain time by comparing with the water quality standards set.

**Data Base**

Database is a collection of data stored systematically in a computer that can be processed or manipulated using application program software to generate information. The definition of database includes specifications in the form of data types, data structures and also the limitation of the data to be stored. The databases is a very important aspect in the information system where the databases isa data storage warehouses that will be processed further. Databases become important because they can organize data, avoid data duplication, unclear relationships between data and are also improved. Database is a collection of information stored in a computer systematically so that it can be checked using a computer program to obtain information from the data base.

**III. METHODOLOGY**

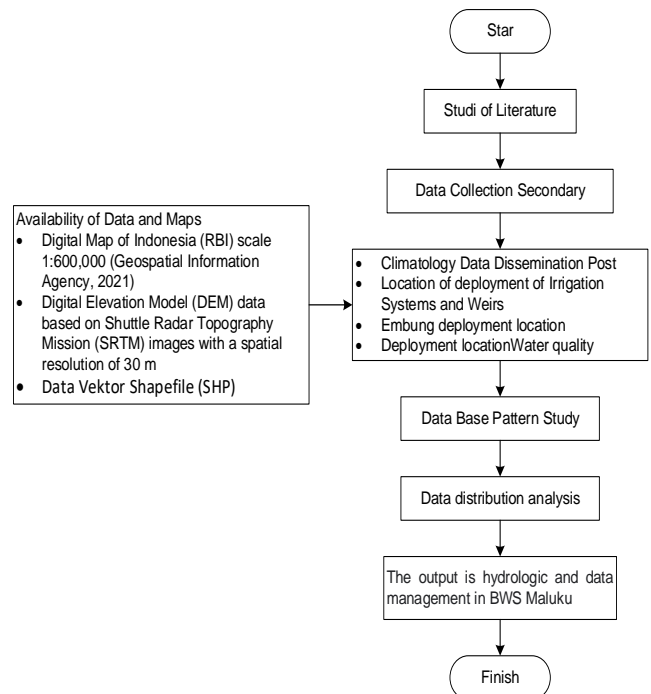


Fig.1 Methodology flow chart

**IV. RESULTS AND DISCUSSIONS**

**1) Analysis of data distribution**

The data analysis of the distribution of hydrological data management of small islands in the Maluku River Region seen in the graphs below.

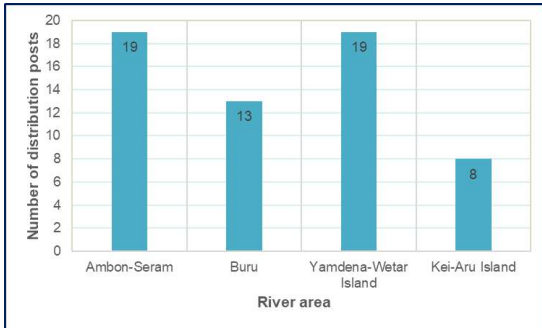


Fig.2 Total Distribution of Rainfall Posts

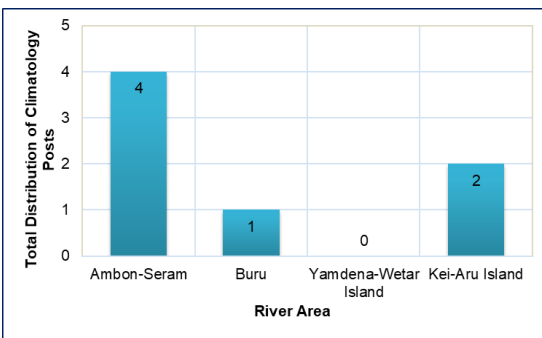


Fig.3 Total Distribution of Climatology Posts

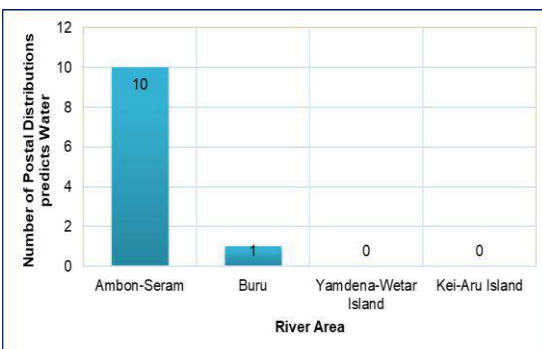


Fig.4 Number of Posts Spreading the water

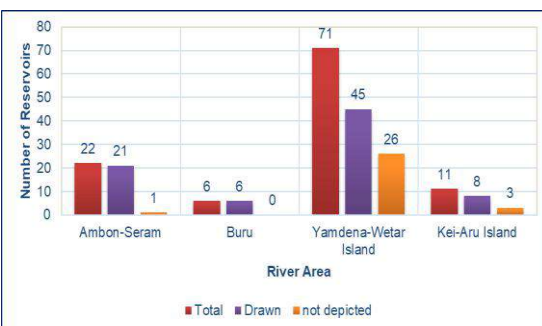


Fig.5 Number of pond Spread

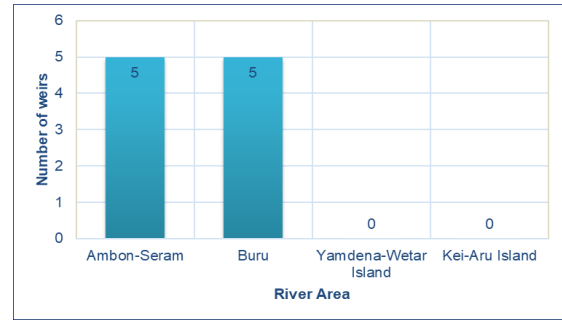


Fig.6 Total Weir Spread

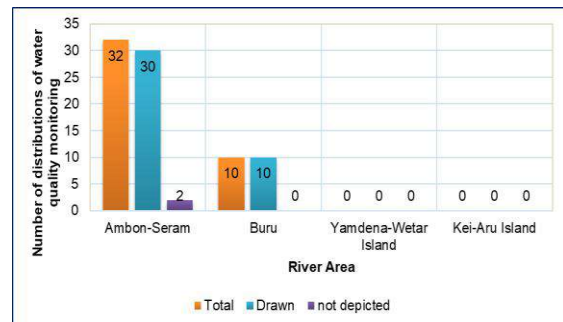


Fig.7 Amount of water quality stabilization distribution

**2) Data base analysis**

The overall analysis of the distribution of Hydrological data in Maluku Province is based on total data as presented in Figure 8 which can be explained that, in fact there are variations related to the distribution of Rainfall Posts, Climatology Posts, Spreading the water Posts, Water Quality Monitoring Posts, pond and weir. Ambon Seram river area, has a total of 92 hydrological facilities, and is the highest number compared to other rivers in Maluku Province, followed by the Yamdena-Wetar river region which numbers 90 facilities. Meanwhile, the river side of Buru and Kei-Aru Islands have a smaller distribution of hydrological facilities with 36 facilities and 21 facilities respectively. From the aspect of the type of facilities, it can be explained that, for river region of Ambon Seram, it turns out to have all types of hydrological condition facilities, but has a Climatology Post that is relatively only 4%, therefore with the existing data needs, the Climatology Post on the Ambon-Seram river region still needs to be improved, in addition to other hydrological conditions facilities. For the river region of Buru, it can be explained that of the 36 hydrological condition facilities, it turns out that 36% is the number of Rainfall Posts, 3% is the number of Climatology Posts, and 3% is the number of Spreading the water Posts, 17% is the number of pond compared to river region Ambon Seram. For the Yamdena-Wetar Islands River, it can be explained that of the 90 facilities of hydrological conditions, it turns out that 79% is the number of pond and 21% is the

number of Rainfall Posts, while they do not yet have hydrological condition facilities in the form of Climatology Post, Spreading the water Posts and Water Quality Monitoring Post compared to other river region in Maluku Province.

For the Kei-Aru Islands River Wilayah, it can be explained that of the 21 facilities of hydrological conditions, it turns out that 52% is the number of ponds, 38% is the number of Rainfall Posts, and 9% is a Climatology Post, while it does not have hydrological condition facilities in the form of Spreading the water Posts and Water Quality Monitoring Posts compared to other river region in Maluku Province.

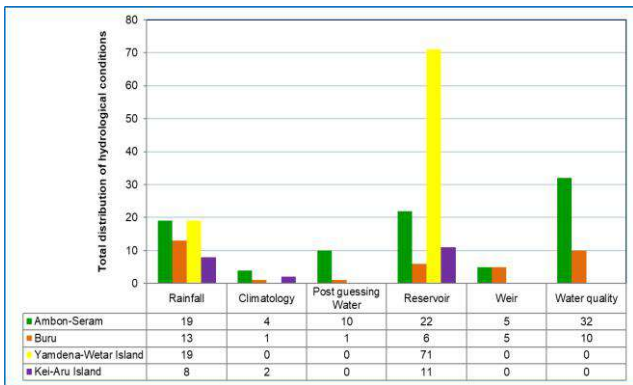


Fig.8 Graph of Distribution of Total Hydrological Data in Maluku

The overall analysis of the distribution of Hydrological data in Maluku Province based on the illustrated data (which has a coordinate position) as presented in Figure 9, it can be explained that, there are variations related to the distribution of Rainfall Posts, Climatology Posts, Spreading water Posts, Water Quality Monitoring Posts, pond and weir. Theriver region of Ambon Seram, has a total of 89 hydrological condition facilities, which is the highest number compared to other rivers in Maluku Province, followed by theYamdena-Wetar Islands River with 64 facilities. Meanwhile, theriver region of Buru and WS Kei-Aru Islands have fewer hydrological facilities with 36 facilities and 18 facilities respectively.

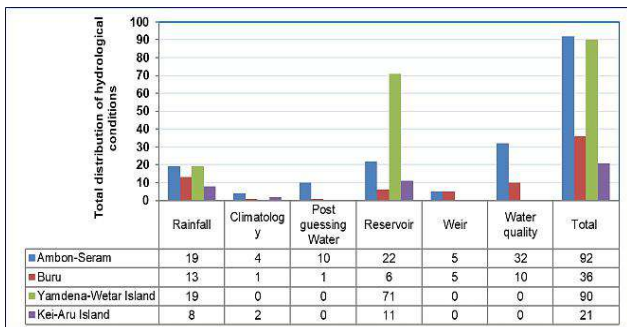


Fig.9 Graph of Hydrological Data Distribution depicted in Maluku

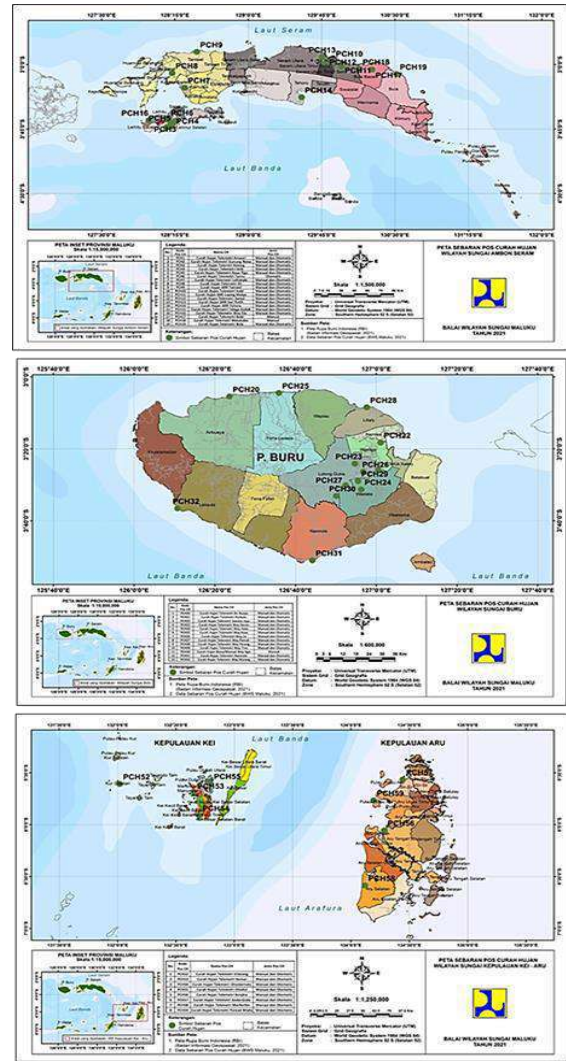


Fig.10 Map of Distribution of Rainfall Posts for Maluku River Basin

From the aspect of the type of facilities, it can be explained that, for the river region of Ambon Seram, it turns out to have all types of hydrological condition facilities, but has a Climatology Post that is relatively only 4%, therefore with the existing data needs, the Climatology Post on the Ambon-Seram river region still needs to be improved, in addition to other hydrological conditions facilities. For the river region of Buru, it can be explained that of the 36 facilities of hydrological conditions, it turns out that 36% is the number of Rainfall Posts, 3% is the number of Climatology Posts, and 3% is the number of Spreading the water Posts, 17% is the number of pond compared to river region Seram.

For the Yamdena-Wetar Islands River, it can be explained that of the 64 facilities of hydrological conditions, it turns out that 70% is the number of pond and 30% is the number of Rainfall Posts, while it does not have hydrological condition facilities in the form of Climatology Posts,

Spreading the water Posts and Water Quality Monitoring Posts compared to other river region in Maluku Province.

For the Kei-Aru Islands river region, it can be explained that of the 18 facilities of hydrological conditions, it turns out that 44% is the number of pond, 44% is the number of Rainfall Posts, and 11% is a Climatology Post, while it does not have hydrological condition facilities in the form of Spreading the water Posts and Water Quality Monitoring Post compared to other river region in Maluku Province.

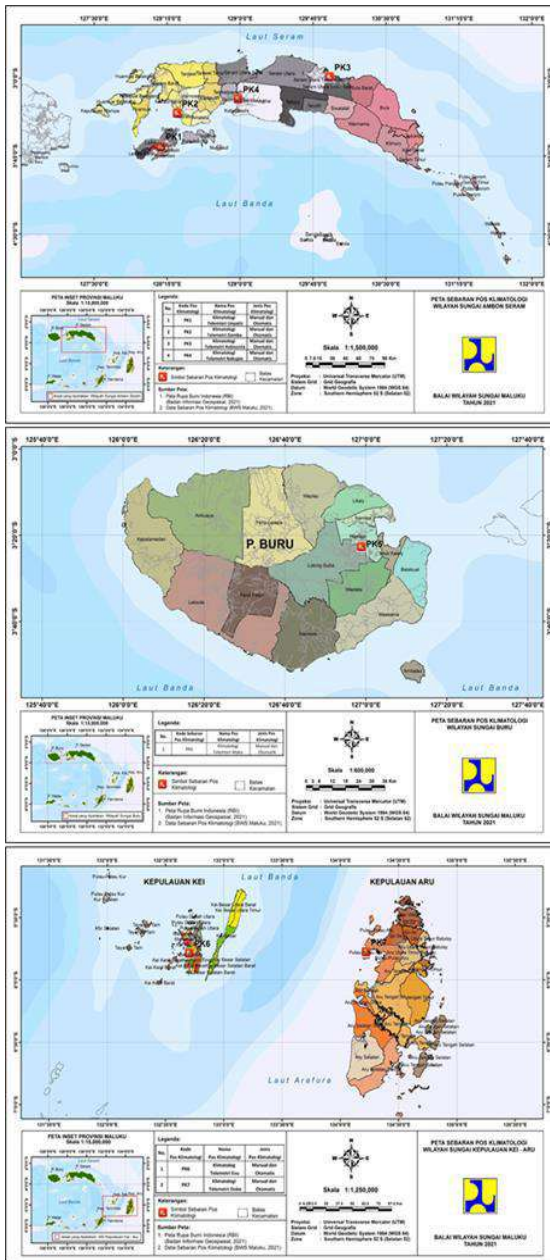


Fig.11 Distribution Map of the Climatology Post for the Maluku River Basin.

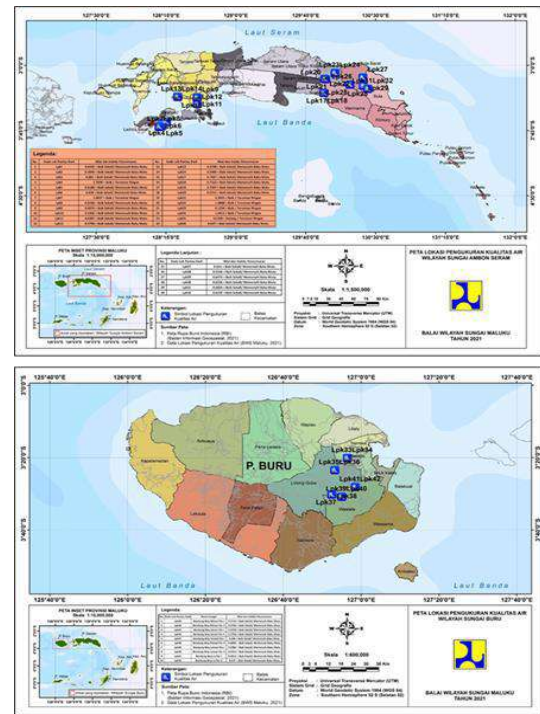


Fig.12 Distribution Map of the Moluccas River Basin Post for Water Consumption

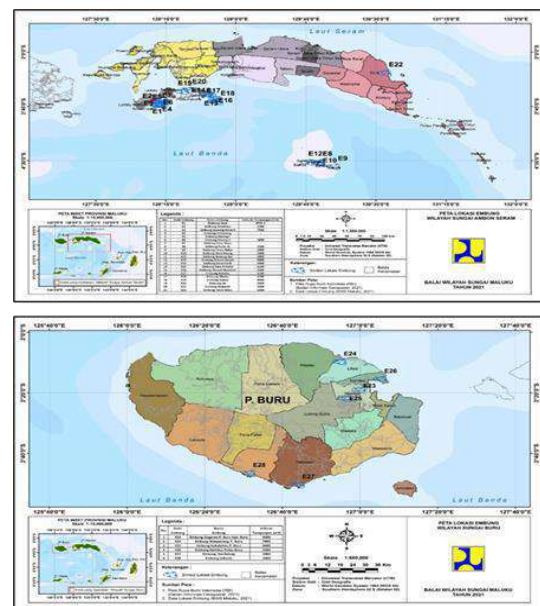


Fig.13 Map of the distribution of the Moluccas River Basin pond



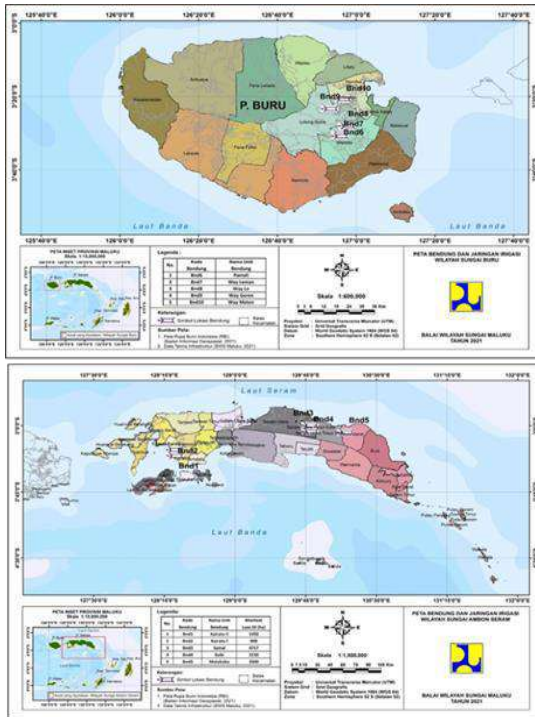


Fig.14 Map of Moluccas River Basin Weir Distribution

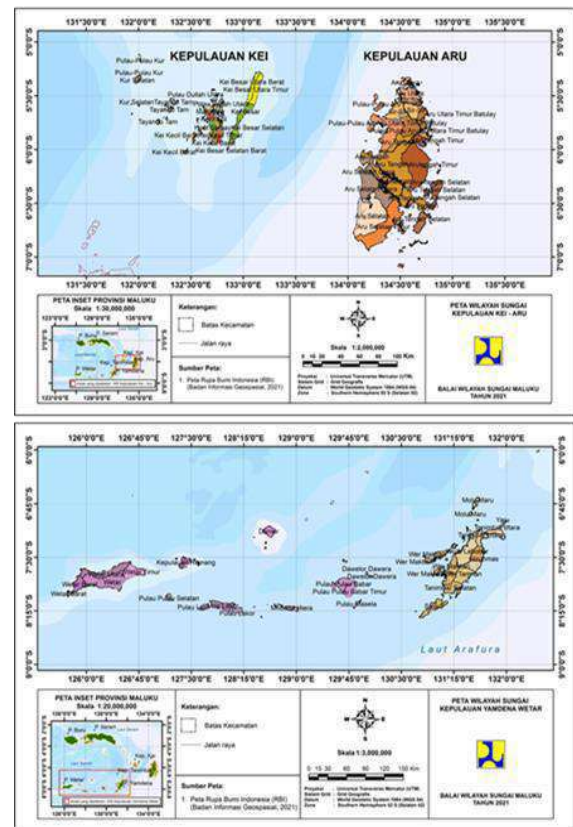


Fig.15 Maluku River Basin Map

V. CONCLUSION

1. Data base management of sustainable water resources on small islands is the main requirement for achieving synergies in building an integrated system in the Maluku River Region.
2. Vital infrastructure facilities are immediately taken seriously both quality and quantity distributed geospatially in all river areas in Maluku Province, so as to reduce the performance role of the system.
3. There are regulations built that have been developed relating to the use and maintenance of measuring instruments at the rainfall and climatological posts.

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# Reduction of Axial Forces in Column in Multistoried Building using Optimum Size Approach at Earthquake Zone III

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**Keywords—** Axial forces, Columns, Strength, Durability, Software Models, High-Rise Structures

**Abstract—** In India, construction plays a very important role with the introduction of high-rise structures that has been increasing gradually. Along with this, the structure should be strong enough that each element should be economic and strong. The Reduction of Axial forces in Columns in Multistory building using Optimum size change approach is a new idea. It reduces the size of columns at the different levels of the building to reduce its self-weight. On other hand, the structural weight should be minimized when the self-weight of the same will be reduced and proved to be an economic structure. In this project a G+13 Storey structure is analyzed using six different cases named as OS Case A to OS Case F assumed to be situated in seismic Zone III. The plinth area is in use as 625 m<sup>2</sup> and all the cases have compared with each parameter. The project concluded that efficient Case is OS Case E on comparing 6 maximum axial force reduction cases that ultimately reduce the overall cost of the project.

## I. INTRODUCTION

In India, Multi-storey building construction is at its peak in big cities because land cost for the construction is going high day by day in large cities of India. The land is minimum against population in the large cities therefore to reduce these problems multi-storey buildings are the only option where minimum land is caused and provide more convenience and safety to the people. To reduce the chances of failure and provide more stability to multi-storey structures under seismic and wind forces many methods and analysis are in trend.

**Axial Force-** If the load on a column is applied through the centre of gravity of its cross section, it is called an axial load. Axial force is the compression or tension force acting in a member. If the axial force acts through the centroid of the member it is called concentric loading. If the force is not acting through the centroid it's called eccentric loading.

Eccentric loading produces a moment in the beam as a result of the load being a distance away from the centroid.

## II. OBJECTIVES & METHODOLOGY

There are different cases considered for different G+13 storied building of same building height, so that response of the seismic behavior of the structure can be predicted. Different models details are shown in table 1 below:

Table 1: List of models framed

S. No	Abbreviation	Models framed for analysis		
		Column Size	Beam Size	Applied Storey
1.	OS Case A	0.65m x 0.60m	0.55m x 0.40m	Up to G + 5
		0.60m x 0.50m	0.55m x 0.35m	Up to G + 13

2.	OS Case B	0.65m x 0.60m	0.55m x 0.40m	Up to G + 5
		0.60m x 0.50m	0.55m x 0.35m	Up to G + 12
		0.60m x 0.45m	0.50m x 0.35m	Up to G + 13
3.	OS Case C	0.65m x 0.60m	0.55m x 0.40m	Up to G + 5
		0.60m x 0.50m	0.55m x 0.35m	Up to G + 11
		0.60m x 0.45m	0.50m x 0.35m	Up to G + 13
4.	OS Case D	0.65m x 0.60m	0.55m x 0.40m	Up to G + 5
		0.60m x 0.50m	0.55m x 0.35m	Up to G + 10
		0.60m x 0.45m	0.50m x 0.35m	Up to G + 13
5.	OS Case E	0.65m x 0.60m	0.55m x 0.40m	Up to G + 4
		0.60m x 0.50m	0.55m x 0.35m	Up to G + 9
		0.60m x 0.45m	0.50m x 0.30m	Up to G + 13
6.	OS Case F	0.65m x 0.60m	0.55m x 0.40m	Up to G + 4
		0.60m x 0.50m	0.55m x 0.35m	Up to G + 8
		0.60m x 0.45m	0.50m x 0.30m	Up to G + 13

Note: Here OS means optimized structure.

**Details of the Models:**

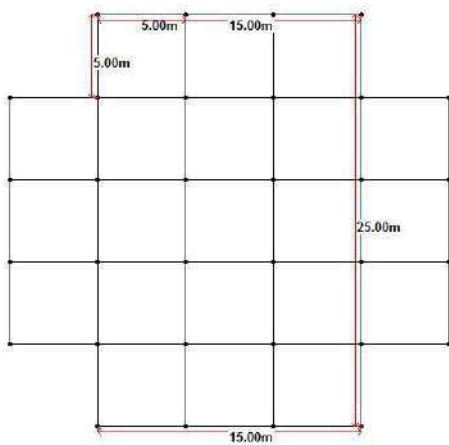


Fig.1: 2D Plan of the Structure

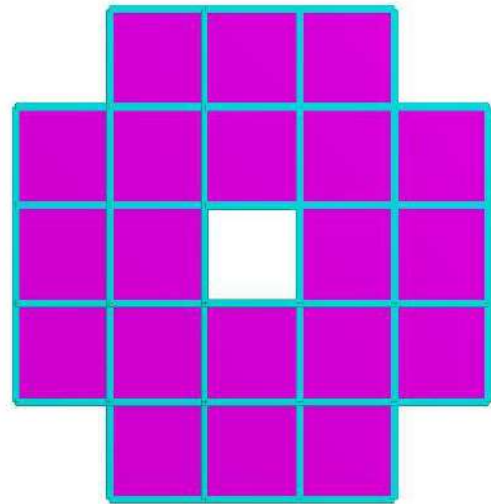


Fig.2: 3D Plan of the Structure

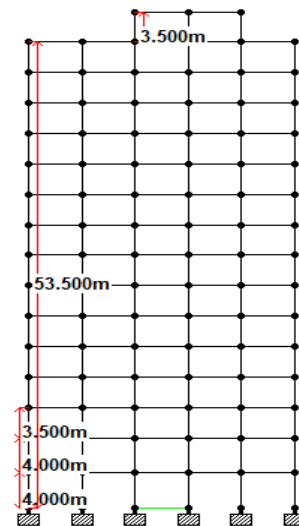


Fig.3: Front View of the Structure

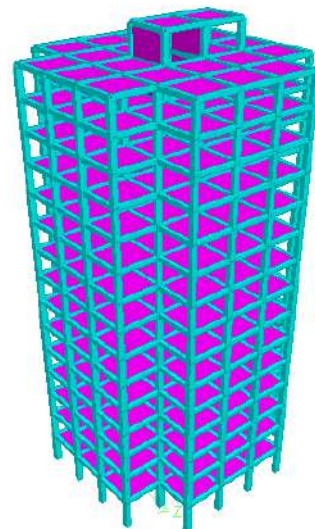


Fig.4: 3D View of the Structure for all cases

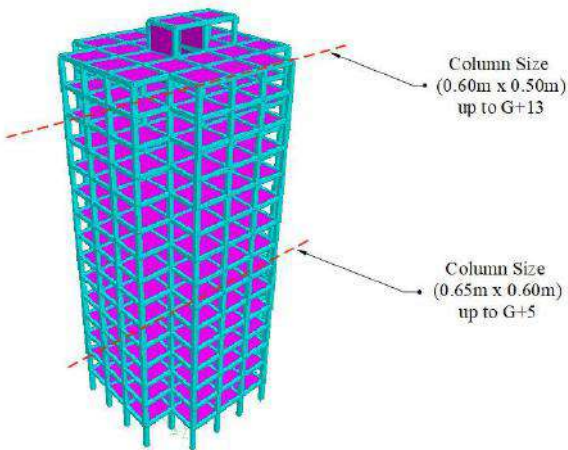


Fig.5: Figure of Axial Force Reduction Case – OS Case A

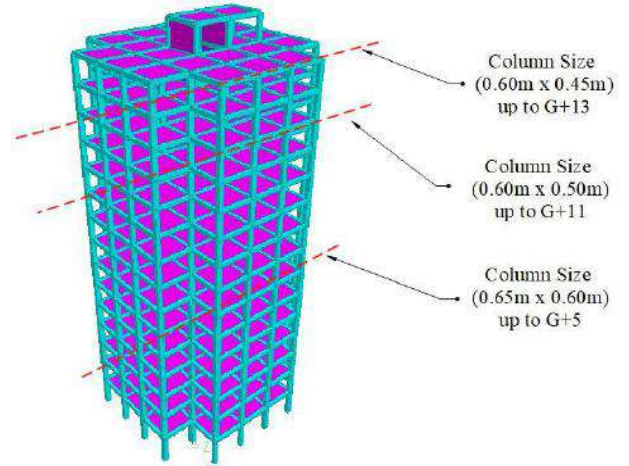


Fig.8: Figure of Axial Force Reduction Case – OS Case D

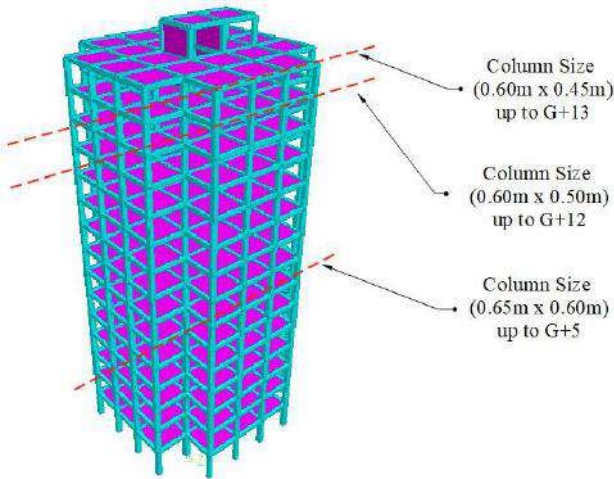


Fig.6: Figure of Axial Force Reduction Case – OS Case B

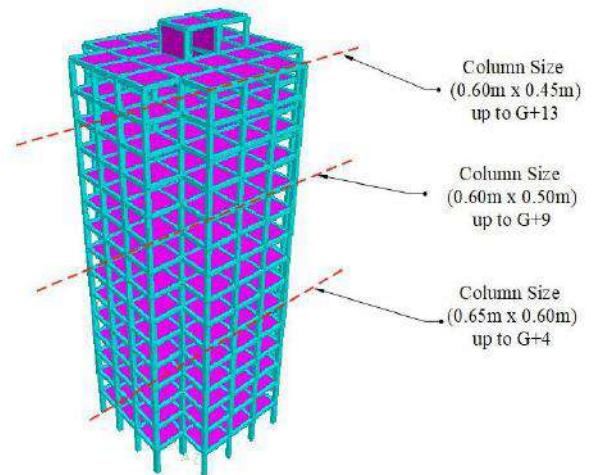


Fig.9: Figure of Axial Force Reduction Case – OS Case E

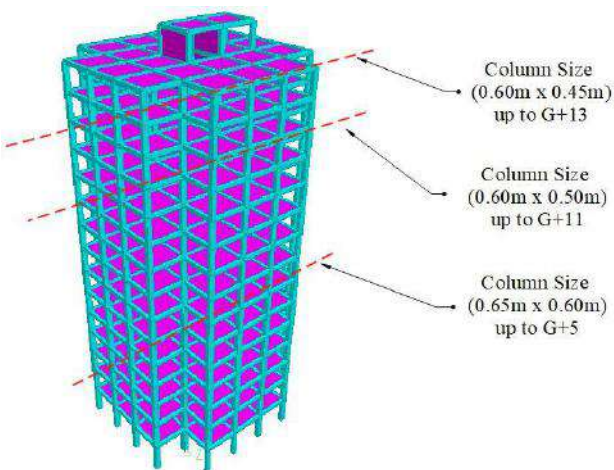


Fig.7: Figure of Axial Force Reduction Case – OS Case C

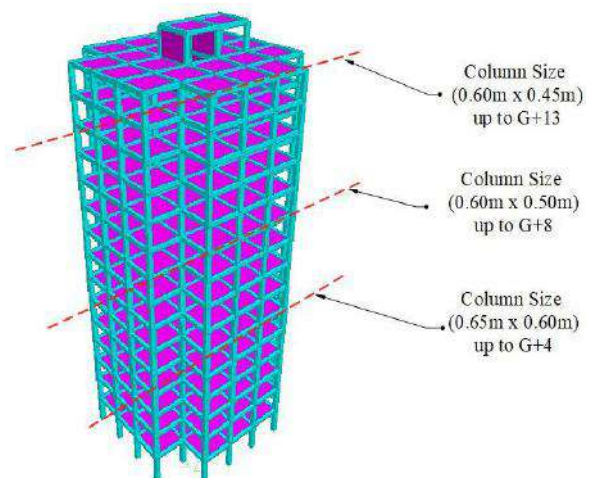


Fig.10: Figure of Axial Force Reduction Case – OS Case F

Table 2: Details of Axial Force Reduction Case –  
OS Case A

Column Size	Beam Size	Applied Storey
0.65m x 0.60m	0.55m x 0.40m	Up to G + 5
0.60m x 0.50m	0.55m x 0.35m	Up to G + 13

Table 3: Details of Axial Force Reduction Case –  
OS Case B

Column Size	Beam Size	Applied Storey
0.65m x 0.60m	0.55m x 0.40m	Up to G + 5
0.60m x 0.50m	0.55m x 0.35m	Up to G + 12
0.60m x 0.45m	0.50m x 0.35m	Up to G + 13

Table 4: Details of Axial Force Reduction Case –  
OS Case C

Column Size	Beam Size	Applied Storey
0.65m x 0.60m	0.55m x 0.40m	Up to G + 5
0.60m x 0.50m	0.55m x 0.35m	Up to G + 11
0.60m x 0.45m	0.50m x 0.35m	Up to G + 13

Table 5: Details of Axial Force Reduction Case –  
OS Case D

Column Size	Beam Size	Applied Storey
0.65m x 0.60m	0.55m x 0.40m	Up to G + 5
0.60m x 0.50m	0.55m x 0.35m	Up to G + 10
0.60m x 0.45m	0.50m x 0.35m	Up to G + 13

Table 6: Details of Axial Force Reduction Case –  
OS Case E

Column Size	Beam Size	Applied Storey
0.65m x 0.60m	0.55m x 0.40m	Up to G + 4
0.60m x 0.50m	0.55m x 0.35m	Up to G + 9
0.60m x 0.45m	0.50m x 0.30m	Up to G + 13

Table 7: Details of Axial Force Reduction Case –  
OS Case F

Column Size	Beam Size	Applied Storey
0.65m x 0.60m	0.55m x 0.40m	Up to G + 4
0.60m x 0.50m	0.55m x 0.35m	Up to G + 8
0.60m x 0.45m	0.50m x 0.30m	Up to G + 13

### Building and Seismic Parameters:

Table 8: Description of parameters taken for analysis

Building configuration	G + 13
Building type	Semi - commercial building
Total plinth area	625 m <sup>2</sup>
Building Length	5m @ 5 bays = 25m
Building Width	5m @ 5 bays = 25m
Height of building from Foundation Level	57 m
Height of each floor	3.5 m
Depth of footing	4 m
Beam dimensions 1	550 mm x 400 mm
Beam dimensions 2	550 mm x 350 mm
Beam dimensions 3	500 mm x 350 mm
Beam dimensions 4	500 mm x 300 mm
Column dimensions 1	650 mm x 600 mm
Column dimensions 2	600 mm x 500 mm
Column dimensions 3	600 mm x 450 mm
Slab thickness	135 mm
Staircase waist slab	135 mm
Shear wall thickness	130 mm
Material properties	Concrete (M30), Steel (Fe 500)

Table 9: Seismic parameters on the structure

Importance factor I	1.2
Fundamental natural period of vibration (T <sub>a</sub> )	0.09*h/(d) <sup>0.5</sup> T <sub>a<sub>x</sub></sub> = T <sub>a<sub>z</sub></sub>
Fundamental natural period (T <sub>a<sub>x</sub></sub> ) for X direction	1.026 seconds

Fundamental natural period ( $T_{az}$ ) for Z direction	1.026 seconds
Response reduction factor R	4
Damping ratio	5%
Zone factor	0.16
Zone	III
Soil type	Medium soil

### III. RESULTS AND DISCUSSION

#### Point of comparison

Following heads shows the point of comparison of result parameters between various models during earthquake forces for building and its various cases. They are as follows:-

- To determine Base shear response when seismic forces are applied in X and Z direction to the structure when size of beams and columns changes at different floor levels.
- To determine and compare member Torsion values in beam and Torsion values in column with efficient case among all 6 axial force reduction cases.
- To examine column Axial Forces with efficient case among all 6 axial force reduction cases.
- To analyze the maximum nodal displacement case in X and Z horizontal plane direction with most efficient case that provides more stability among 6 axial force reduction cases.
- To determine storey drift in both X and Z direction with efficient case among all 6 axial force reduction cases.

Table 10: Maximum Displacement in X direction for all Axial Force Reduction cases

Model Cases	Maximum Displacement (mm)
	For X Direction
OS Case A	209.286
OS Case B	209.157
OS Case C	209.669
OS Case D	210.624
OS Case E	214.184
OS Case F	215.923

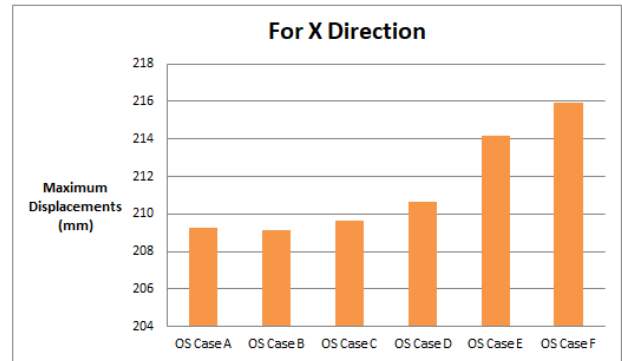


Fig.11: Graphical Representation of Maximum Displacement in X direction for all Axial Force Reduction cases

Table 11: Maximum Displacement in Z direction for all Axial Force Reduction cases

Model Cases	Maximum Displacement (mm)
	For Z Direction
OS Case A	186.431
OS Case B	187.768
OS Case C	189.257
OS Case D	190.968
OS Case E	195.036
OS Case F	197.133

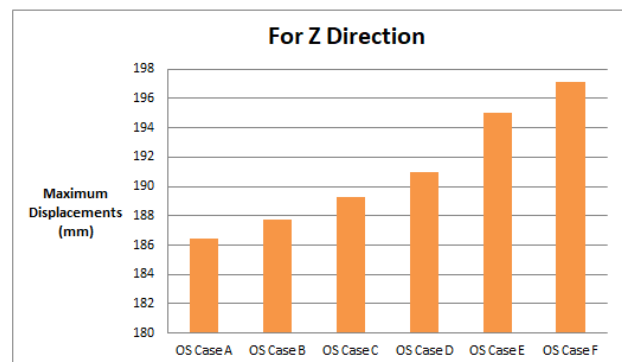


Fig.12: Graphical Representation of Maximum Displacement in Z direction for all Axial Force Reduction cases

Table 12: Storey Drift in X direction for all Axial Force Reduction cases

S. No.	Height (m)	Storey Drift (cm)					
		For X Direction					
		OS Case A	OS Case B	OS Case C	OS Case D	OS Case E	OS Case F
1	0	0	0	0	0	0	0
2	4	0.5141	0.5133	0.5127	0.5121	0.5107	0.5103
3	8	0.937	0.9357	0.9348	0.934	0.9325	0.9321
4	11.5	0.9717	0.9703	0.9695	0.969	0.9688	0.9687
5	15	1.0893	1.0878	1.0871	1.0868	1.0884	1.0887
6	18.5	1.1721	1.1706	1.17	1.1699	1.1736	1.1744
7	22	1.2258	1.2243	1.224	1.2243	1.2215	1.2231
8	25.5	1.2472	1.2458	1.2458	1.2464	1.313	1.3157
9	29	1.3119	1.3106	1.311	1.3124	1.3287	1.3331
10	32.5	1.3006	1.2995	1.3005	1.3029	1.3176	1.3243
11	36	1.264	1.2633	1.2652	1.269	1.2841	1.2904
12	39.5	1.2058	1.2056	1.2088	1.2145	1.2277	1.2657
13	43	1.1289	1.1297	1.1346	1.1399	1.1803	1.205
14	46.5	1.0387	1.0408	1.0453	1.0752	1.1032	1.1134
15	50	0.9419	0.9435	0.9691	0.9887	1.0041	1.014
16	53.5	0.8057	0.8245	0.8412	0.8502	0.8648	0.8732
17	57	0.8745	0.8879	0.9062	0.9193	0.937	0.947

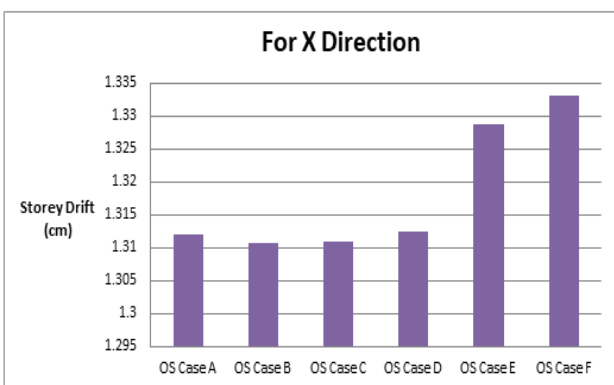


Fig.13: Graphical Representation of Storey Drift in X direction for all Axial Force Reduction cases

Table 13: Storey Drift in Z direction for all Axial Force Reduction cases

S. No.	Height (m)	Storey Drift (cm)					
		For Z Direction					
		OS Case A	OS Case B	OS Case C	OS Case D	OS Case E	OS Case F
1	0	0	0	0	0	0	0
2	4	0.3646	0.3643	0.3642	0.3641	0.3465	0.3467
3	8	0.7321	0.7317	0.7317	0.7321	0.6879	0.6889
4	11.5	0.8457	0.8454	0.8458	0.8466	0.7903	0.792
5	15	1.0071	1.0071	1.0079	1.0093	0.9392	0.9418
6	18.5	1.1295	1.1299	1.1313	1.1334	1.0535	1.0573
7	22	1.221	1.2218	1.224	1.2271	1.1248	1.1299
8	25.5	1.2701	1.2716	1.2746	1.2788	1.2261	1.2334
9	29	1.3565	1.359	1.3634	1.3694	1.2579	1.2676
10	32.5	1.37	1.3738	1.3799	1.3879	1.2703	1.2836
11	36	1.3658	1.3712	1.3793	1.39	1.2605	1.2695
12	39.5	1.3389	1.3464	1.3571	1.3716	1.2256	1.2671
13	43	1.2952	1.3052	1.3197	1.33	1.2052	1.2226
14	46.5	1.2408	1.2545	1.2655	1.3096	1.1495	1.166
15	50	1.1875	1.1985	1.2415	1.2623	1.0933	1.1094
16	53.5	1.0979	1.1386	1.1595	1.1795	1.0106	1.0255
17	57	1.3838	0.967	0.9903	1.257	0.8292	0.8422

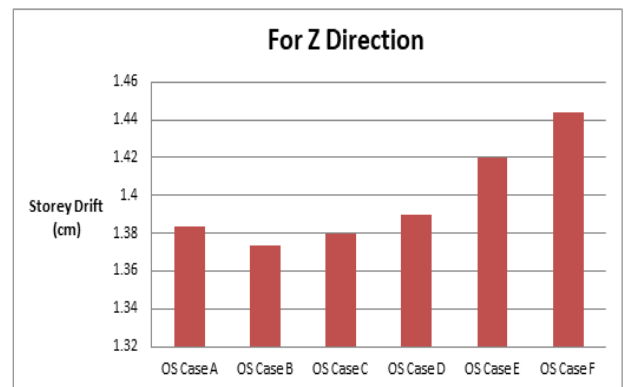


Fig.14: Graphical Representation of Storey Drift in Z direction for all Axial Force Reduction cases



Table 14: Base Shear in X and Z direction for all Axial Force Reduction cases

Model Cases	Base Shear (KN)	
	X direction	Z direction
OS Case A	5192.32	6167.61
OS Case B	5188.19	6156.67
OS Case C	5177.71	6139.10
OS Case D	5165.44	6118.11
OS Case E	5119.21	6054.94
OS Case F	5115.13	6034.89

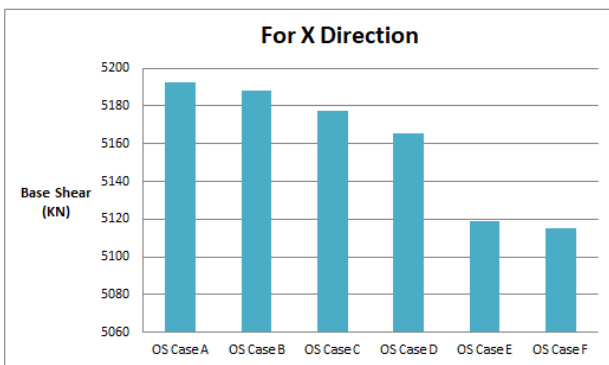


Fig.15: Graphical Representation of Base Shear in X and Z direction for all Axial Force Reduction case

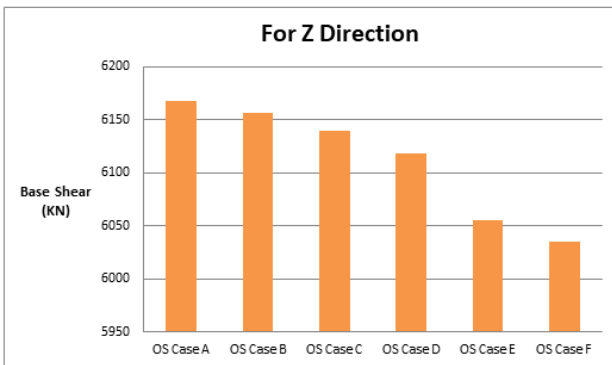


Fig.16: Graphical Representation of Base Shear in Z and Z direction for all Axial Force Reduction case

Table 15: Time Period and Mass Participation Factor for all Axial Force Reduction cases

Model Case	Time Period (Sec.)	Participation X %	Time Period (Sec.)	Participation Z %
OS Case A	2.452	57.205	2.583	70.447

OS Case B	2.451	57.17	2.584	70.339
OS Case C	2.451	57.107	2.587	70.203
OS Case D	2.453	57.042	2.593	70.038
OS Case E	2.466	56.997	2.615	69.714
OS Case F	2.471	56.947	2.624	69.518

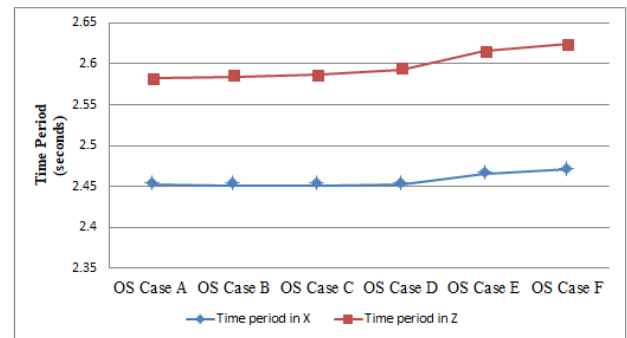


Fig.17: Graphical Representation of Time Period Time Period for all Axial Force Reduction cases

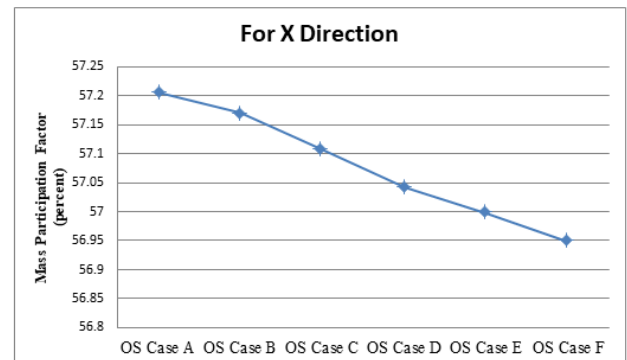


Fig.18: Graphical Representation of Mass Participation Factor in X direction for all Axial Force Reduction cases

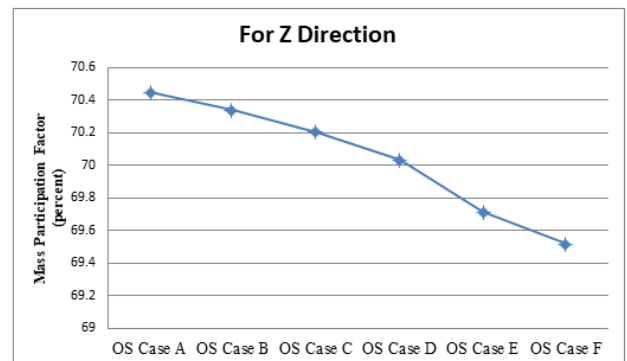


Fig.19: Graphical Representation of Mass Participation Factor in Z direction for all Axial Force Reduction cases

Table 16: Maximum Axial Forces in Column for all Axial Force Reduction cases

Model Case	Column Axial Force (KN)
OS Case A	10734.37
OS Case B	10720.15
OS Case C	10715.47
OS Case D	10714.54
OS Case E	10734.36
OS Case F	10743.193

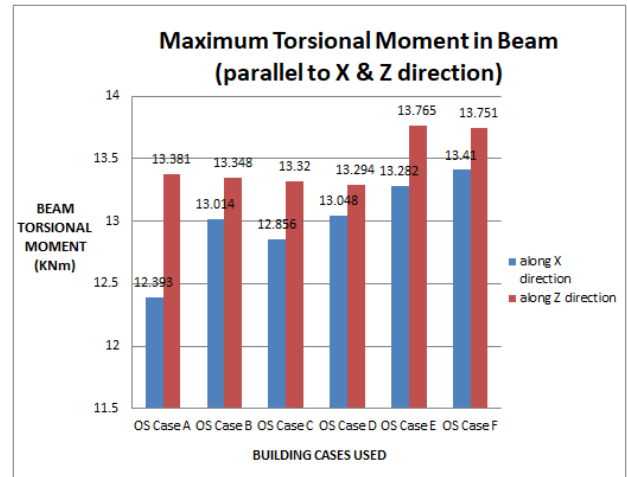


Fig.21: Graphical Representation of Maximum Torsional Moment in beams along X and Z direction for all Axial Force Reduction cases

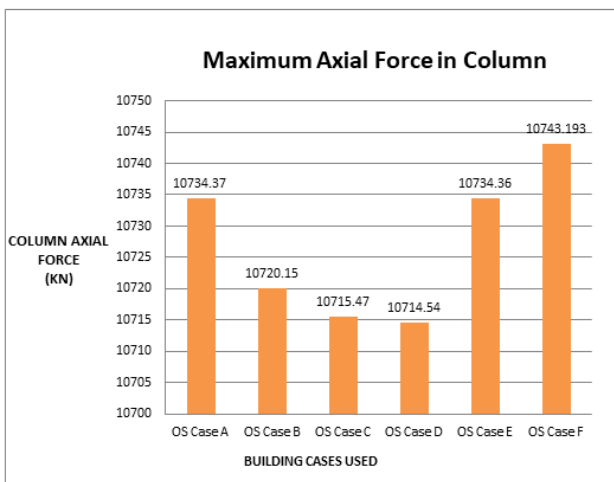


Fig.20: Graphical Representation of Maximum Axial Forces in Column for all Axial Force Reduction cases

Table 17: Maximum Torsional Moment in Beams along X and Z direction for all Axial Force Reduction cases

Model Case	Beam Torsional Moment (along X direction) (KNm)	Beam Torsional Moment (along Z direction) (KNm)
OS Case A	12.393	13.381
OS Case B	13.014	13.348
OS Case C	12.856	13.32
OS Case D	13.048	13.294
OS Case E	13.282	13.765
OS Case F	13.41	13.751

Table 18: Final conclusive outcomes

S. No.	Abbreviation	Models framed for analysis			Member Status
		Column Size	Beam Size	Applied Storey	
1.	OS Case A	0.65m x 0.60m	0.55 m x 0.40 m	Up to G + 5	Passed
		0.60m x 0.50m	0.55 m x 0.35 m	Up to G + 13	
2.	OS Case B	0.65m x 0.60m	0.55 m x 0.40 m	Up to G + 5	Passed
		0.60m x 0.50m	0.55 m x 0.35 m	Up to G + 12	
		0.60m x 0.45m	0.50 m x 0.35 m	Up to G + 13	
3.	OS Case C	0.65m x 0.60m	0.55 m x 0.40 m	Up to G + 5	Passed
		0.60m x	0.55 m x	Up to	

		0.50m	0.35 m	G + 11	
		0.60m x 0.45m	0.50 m x 0.35 m	Up to G + 13	
4.	OS Case D	0.65m x 0.60m	0.55 m x 0.40 m	Up to G + 5	Passed
		0.60m x 0.50m	0.55 m x 0.35 m	Up to G + 10	
		0.60m x 0.45m	0.50 m x 0.35 m	Up to G + 13	
5.	OS Case E	0.65m x 0.60m	0.55 m x 0.40 m	Up to G + 4	Passed
		0.60m x 0.50m	0.55 m x 0.35 m	Up to G + 9	
		0.60m x 0.45m	0.50 m x 0.35 m	Up to G + 13	
6.	OS Case F	0.65m x 0.60m	0.55 m x 0.40 m	Up to G + 4	Fail
		0.60m x 0.50m	0.55 m x 0.35 m	Up to G + 8	
		0.60m x 0.45m	0.50 m x 0.35 m	Up to G + 13	

#### IV. CONCLUSIONS

Reduction of Axial Forces in Columns in Multistoried Building under seismic loading, as we investigate concerning the decrease of axial force of six different model made in analysis software and here is such a sort of

conclusion regarding each models for find out the minimum axial force in the structure. In term of given models subsequent outcome are take out from this proportional study.

- On comparing all six models it has been concluded that the maximum displacement in OS Case B in X and OS Case A in Z direction.
- On comparing all six models it has been concluded that the maximum Storey Drift in OS Case B in X and Z direction.
- As per comparative results in Base Shear, OS Case F is very effective than other models in both X and Z.
- As per comparative results in Mass Participation Factor, OS Case F is very effective than other models in both X and Z.
- As per comparative outcome in axial force, OS Case D is very effective than other models.
- On analyzing the Torsional Moment in beams along X direction and Z direction OS Case C and OS Case D is efficient respectively.

As far as concern the reduction of Axial Forces in Columns in Multistoried Building under seismic loading with different size of members in different top floors concluded that OS Case E is very effective in axial force comparing OS Case A to F the axial forces are decreased and OS Case E is identified the least axial force. OS Case F has failed in structural components when analysis has done and its axial force is higher than other cases.

As per the above analysis states that mention above all the cases OS Case E is very effective and safe case among all and can be recommended when this type of construction will take place.

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# Microcultures and the nationalist speech

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**Keywords— National cultural identity.  
Microcultures. Decentering.**

**Abstract—** This article was about the theme of national cultural identity and the effects on microcultures. Its objective was to discuss about the constitutive processes of an imagined community and its influences on microcultures. The theoretical/methodological foundation was supported, among others, in the studies of: Anderson (2008), who discuss the concept of imagined community, national consciousness; Bachelard (2008), with the metaphor of the house, basement, attic; Hall (2014, 2019) and the concepts of erasure (X), cultural identity, national identity; Bhabha (1998), based on the idea of ambivalence; Bauman (1999), with the concept of the nation-state; Said (2004, 2011) and out of place concepts, overlapping identity, territory, intertwined histories, structure of attitudes and behaviors, imperialism; and Maingueneau (2015), especially the concept of discursive ethos. It was a qualitative research, with an exploratory approach. The results showed that there is an active process of decentering the conception of a fixed national identity. And, because of this character, it seeks, by different means, to limit the expression of cultural differences of gender, class, sexuality, religiosity.

## I. INTRODUCTION

In this article we discuss the problem of national identity and its relationship with the identity of microcultures. In this sense, we discuss regional and global conflicts about what has sustained an imagined community and its supposed uniqueness. Which has been one of the most prominent themes when it comes to identity and difference. This justification not only managed to motivate the study, but also brought about the possibility of understanding some inconsistencies between what is currently happening within nationalist discourses. In this context, what are the processes that shape the identity of an imagined community? This was the guiding question of the research, whose objective was to discuss the constitutive processes of an imagined community and its influences on microcultures. With this objective in mind, we undertook an exploratory, qualitative research. Among others, the theoretical foundation was based on the studies

of: Anderson (2008), who discuss the concept of imagined community national consciousness; Bachelard (2008), with the metaphor of the house, basement, attic; Hall (2014, 2019), with the concepts of erasure (X), cultural identity, national identity; Bhabha (1998), based on the idea of ambivalence; Bauman (1999), with the concept of the nation-state; Said (2004, 2011) was borrowed from the concepts, out of place, overlapping identity, territory, intertwined histories, structure of attitudes and behaviors, imperialism; and Maingueneau (2015), especially the concept of discursive ethos. The research was structured as follows: in the first item we present the introduction, with its constitutive aspects (theme, justification, problem, objective, theoretical and methodological foundation); in the second item we discuss the problems triggered by the issue of national identity and its consequences in relation to microcultures; then we discuss its results in a brief conclusion. We infer that the debate is still active in

several arenas about discrimination and exclusion, via a supposed neo-imperialist national identity unit.

## II. ETHOS DISCURSIVO DA FORMAÇÃO IDENTITÁRIA NACIONAL

Said (2004) arguments regarding the strength of representation in the construction of identities is something that deserves analysis. In his autobiographical text, out of place, he embodies the legacy of an entire experience of oppression within the family. So, what does Said really mean when he claims he was out of place? Or rather, that he was always out of place? Would your father, mother and aunt Melia be living alienated in a social environment, peacefully, except Said? These primary questions refer to what he presents, right at the beginning of his text; every family invents its history, giving each of its members defined roles to be performed within the institution. The curious thing for Said is that, as he himself exposes, it seems that his character was poorly chosen, as over time he could not adapt to the functional experiences that were demanded of him. This we would say, according to Said, no one can really bear the weight of an alienating construction, a precarious family of relationships, dual nationality, dual personality, rigidity of behavior. From Said's family history, at the limit, it really seems that everyone and everyone were out of place. Said's (2004) dissatisfaction with the family model imposed on him was so ingrained in his being that his own name, his own social and civil identity, smelled bad. How to get a name and hate it for the rest of your life? What could that ungrateful name "Edward" have that caused him so much discomfort? Said thinks to himself about his personal identity and his national identity. One of the most provocative provocations distilled by Said's own words was knowing that his first name was of English origin, while his second, or his partner, in the author's own language, was Arabic. To live this duplicity, this hybridity is in fact never to be found uniquely and exclusively in one place. Well, we would say, our author is one of the children of the diaspora. Term widely publicized by Hall (2013). And this condition, according to this author, permeates contemporary life.

The reflections forwarded by Said (2004) allow us to enter our individual being, make a deep diagnosis and return to the surface of ourselves and undertake the analysis of where we are, what space have we occupied, when, in what situation? In which nation? Nation? A term that is widely questioned today, as it has come back against, if we can say so, its demands in relation to its imposition of identity. Said (2004) performs that exercise postulated by Bachelard (2008) of descending into the basements of his

existence, digging through what he has at the base of his support; which has guaranteed the socio/historical and cultural profile of your family. And that makes him come across findings, and of course a great deal of hypotheses. Said (2004) wants to know how his family became what it is, what it could be or not. He questions the private life of his father, his mother and then his aunt, his known relatives. Said wants to know why he is what he is and could be; her aunt, her paternal and maternal relatives, cleans up everyone's life and daily life. As he descends to the basements of his house, he interrogates the houses close to them. Said is not in the in-between, commonplace, space of practice; it oscillates between what Bachelard (2008) calls the vertical level and centrality. These two poles, we could say, considering the metaphor of the house, basement and attic. The basement, place of our stereotypes, rationality, but also irrationality; and the attic would be linked to dreams, daydreams, dreamlike, imagination, dream. The reason is that these two sectors of the house are not separate, but complement each other. We would say that Said (2004) makes an adjustment to these terms by showing his imagery and his images that perhaps very few could devise. Calling into question his own values, his education and how he used the precepts imposed by a traditional family seemed to him an arduous exercise; again, just as Bachelard (2008) invites everyone to check their homes, observe their spaces, as we have occupied a space or all possible spaces, could this teach us to live fully? And what about the beyond-basement issue? We would say that Said competently made this journey. Starting from his dissatisfaction taking root throughout his family and bringing to the surface basic elements for us to think about our cultural identity, our national identity. These problems run through Said's discourse from his own name to his bipartite nationality. What a basement and an attic, Bachelard would say. It seemed to suggest that he was able to do something positive with what they did to him. It is a fact that we all have our cultural identity. And we live this identity within a larger space called the nation. But recently we have heard a lot about the globalizing processes of the old categories that underpinned our most immediate experiences. It is a real challenge to follow (HALL, 2019; BAUMAN, 1999) these concerns, which have made the exercise of showing us how the debate about the invention of nation-states or the well-known cultural identity, together with national identity, has been questioned within a current discursive debate. This is the moment to analyze how we have been surreptitiously agreeing on the existence of a solid, monolithic nation, confident in an idea of a nation in solidarity with its individuals. In fact, it is a discursively formed set, with its objectives well delimited spatially and temporally. Said

(2011) makes an in-depth analysis of this context that he calls overlapping territories. Yes, he adds that we live in a time of intertwined stories. Could we say that we are in a new paradigm totally absent from what Said calls imperialism? Or these "intertwined" terms, "overlapping" means something else? It is in this sense that we can seek to understand two poles radically analyzed by Said. He criticizes European imperialism, which has long been the main villain in the representative history of cultures. An example of this is the so-called representational orientalism in which Europeans discursively construct a particular way of what is different from oneself; this aim intends to more effectively welcome in its interior, as a manipulation and cultural colonization strategy, its other. A kind of coupling that everything and everyone wants to keep under his command. Also according to Said (2011), this exploratory maintenance of the identity of difference is processed by strategic means, making abusive use of literature and media resources on a large scale. The invention of an imaginary is fundamental in this case. Maffesoli (2001) points out that the imaginary is the spirit of a people. And as has been widely publicized in the work of Bauman (1999), technology has served certain groups, which find it easy to handle their capital, to the detriment of the scarcity of many more people who cannot access virtual technology. However, the imaginary, as Maffesoli (2001) says, is something that goes beyond rationality, and much of its content comes close to irrationality, subjectivity, expression. In this sense, we would say that it is through specific images of a Eurocentrist imaginary that the cultural manipulation of difference takes place. But it seems that, on a certain level, it's unconscious. In which everyone accepts political/social contracts. According to Bhabha (1998), using the concept of ambivalence, it is possible to understand the problem of identity and difference. If we are dealing with imperialism, or colonialism and colonized, it is a key term that allows us to understand the psychology of what is outside, what is contingent and must be denied to fit within the unique and monolithic parameters of a colonizer. The difference must be annihilated, it must be hidden away, or even hidden. It's not that it's not recognized, but it's still denied. And all machinery involves a thousand-faced stereotypes; intertwined by metaphor on the one hand and metonymy on the other. Some authors have worked on the concept of imperialism, colonization, and local cultures. The essence of this discussion highlights the problem that some aim to attribute to the colonizer's processes as the only and exclusive source of all the chaos and discrimination to those outside the dome of the great European powers. England, it seems, is one of the most condemned for its overseas extension of industrial architecture. Here, as an

addendum, the question of European colonizing exploitation is not a recent fact, it has a long history and corresponds to the first navigations. Todorov (2019), in his work *The Conquest of America*, highlights this episode in many details, at least when it comes to America. A fact that Hall (2019) also confirms. Said (2011) emphasizes that, for many historians of the Empire, it began in 1878 with the dispute for Africa, but indicates that his analysis of cultural hegemony is well systematized at the end of the 18th century; with Napoleon's conquests, industrial development, the rise of European nationalism and nation-state, as well as the consolidation of the power of the bourgeoisie. Said's (2011) complaint is that when some authors do not blame Europe as the cradle of all regrets for the usurpation of cultures, they observe that the nation-states, which could serve as an instrument of decentering historical imperialism, also present themselves as disciplinarians, element of unification, of negation of other manifestations. How to understand that – if we can observe with the naked eye the damage of European imperialism in the life of their respective colonies – today, in a world known for democracies, or fragmented into national identities, does oppression practically continue? The Brazil of today can be placed, in this case, as a clear example. Can we openly say that living in a nation would be an advantage? What Said (2011) seems to imply is that this element is an extension of the old form of colonization, attitudes, and behaviors of cultural diversity. Bauman (1999) also finds that nation-states, in a context of globalization, are nothing more than police entities, which can interfere in politics, but not even think about it in the economy. In any case, considering a nation and its nationalist identity is to maintain a single and exclusive generalizing identity. But what about that cultural multiplicity, which Cultural Studies has been pointing out, which has always existed, and which only at great cost has surfaced in some apparitions? Here we return to Bachelard (2008): what is the use of having an entire house, a mansion and not being able to live it in its entirety? Although we indicate that it is necessary to go down to the cellars, it seems to be necessary an activism that can also dream, that can show itself as diversity, an option. One theme I address is the difficult relationship between nationalism and liberation, two ideals or goals of people committed against imperialism. Generally speaking, it is true that the creation of numerous recent independent nation-states in the post-colonial world has restored the primacy of so-called imagined communities [...] plundered by a legion of dictators and tyrants, embedded in various state nationalisms. . (SAID, 2011, p. 106). We can glimpse the strident way in which Said (2011) has seen the issue of the invention of imagined communities, which could be

established as another mode of social coexistence. With the collapse of the old empire, modern States did in fact appear, but they have not fulfilled the role of liberating individuals from the condition of colonized. In this sense, Said suggests that there is an interaction in the whole of the cultural work. It can be a way to streamline cultural studies. Even because it doesn't pay, if we want to give visibility to microcultures, to fix the analysis sometimes in the imperial pole, sometimes in the national one. The idea that the author presents is a broad study of understanding; understanding how the process of maintenance and development of a single and dominant thought happens (BHABHA, 1998), which prevents the manifestation of multifaceted reality. It is from this perspective that, instead of judging hastily, we have to try to understand how it happens and then act accordingly, so that there is a consequent activism. This seems to have been what Fanon (2008) sought to do in *Pele negra, white masks*. How else could we think about this serious dual problem? We have come out of a dangerous imperialist regime and into rigid nationalism with a false national identity, a linguistically compressed monolithic compact bloc, not to mention political right and left, or extreme right. May it bring any and all manifestations other than itself; an ethos of usury. If micronarratives manage to find a way out of this problem, since there is no way to expect nationalists to do so, it may be the opportunity to emerge a new way of building projects for life that are less exclusionary and discriminatory. Said (2011, p. 106) draws attention, once again, to the danger of enthroning cultures; he warns that "vigilance and self-criticism are fundamental, as there is an intrinsic risk to the opposition's work of institutionalizing itself, of the marginality of turning into separatism, of the resistance of erecting itself into dogma". In effect, it could be reproducing a historically overwhelming pattern. The watchword is to unblock the old canons, a veiled imperialism called by the author structures of attitude and behavior. Or structures of sensitivities, as we have already pointed out, using the most diverse mechanisms to seize the spirits of men, women, children and everything else. Anderson (2008), in his study of the origins of national consciousness, strongly points out that the press played a fundamental role in founding what he calls imagined communities. These are historical-linguistic constructions, among other characteristics, according to Anderson, they have been placed in place of instruments in the territorial condensation demarcated through languages. The author makes a historical overview presenting in a radical way how, after the advent of the typographic press, the way of life in all parts of the world was dynamized mainly by the European capitalist mode of production; and that the capitalist project used it efficiently as a motto for

disseminating ideas and accumulating capital. For the interests of the objective proposed here, it is important to understand the relationship between the appearance of printed text technology and how languages emerged due to its bias; and if all languages had their space guaranteed in this scenario. According to Anderson (2008), before nation-states as we know them today, there were dynasties that used administrative functional vernaculars. And with the passage of time, the production of texts became more and more intense and conquered territories that were previously unthinkable, conveying the written codes. This dissipation was boosted by the fact that it democratized ideas that were previously the objects of the religious privileged, in particular. After the fall of Latin, new languages were emerging. Anderson explains that before the press there were many dialects and that they gradually condensed due to the fusion and ease of dissemination of the written press. Still according to Anderson, there were poor cousins and related languages for ease of dissemination. These became the main, official ones, demarcating territories, and those less functional vernaculars, if we may say so, were left on the sidelines; those ended up constituting what we call Modern States. The languages that were organizing and demarcating their fields, however, were also constituting the identities of certain individuals, who acquired the awareness that the same spoken language was also an instrument of communication for other tens of hundreds or thousands of other individuals. Anderson calls this the visibility of invisibility. It is curious to note that not all nation-states, no matter how much they have made a certain language official for all speakers or if such a feat has been attempted, there are nations that demonstrate atypical in this sense, of imposition and reciprocal obedience. Brazil, for example, speaks Portuguese as the official language; Africa, although it has its language, according to Anderson, some groups prefer its vernaculars. Other examples are also covered by the author. The intention is to show that there is no equality in dealing with languages as demarcators of national communities. The "[...] concrete formation of contemporary national states does not have any isomorphic relationship with the scope of specific printed languages" (ANDERSON, 2008, p. 83). In the delimited framework, the conflictive character is evident, involving a great load of power in relation to the dynamics of language production. Anderson (2008) presents three important factors about the emergence of a nation's consciousness; this issue in which the press has an unquestionable role, according to the author. The first determinant was the form of capitalist production; the second aspect was press technology; and the third was the diversity of languages existing in the communicative



practices of human experiences. This entire framework favored the events emerging from the fall of classical Latin as an instrument of the sacred and exclusive to a small bilingual elite; with the explosion of the Reformation with Martin Luther, 1517, and with the gradual dissemination of administrative vernaculars.

It is important to remember that this whole state of affairs did not happen consciously, at least initially, until it became organized languages (ANDERSON, 2008). However, there is no doubt that, after their decantation, they have not been used frequently as instruments that are Machiavellian excluding the other. Weapon of discrimination and prejudice with less clear vernaculars. The author presents some examples, the case of Thai minorities, prevented from textually organizing their dialects, as well as Turkey, which, winging itself to nationalism, is strongly opposed to Islamic influences; but in our reality the creole, the indigenous languages, to cite a sample, go through the same arena with the national printed language. Hall (2019) makes reference to the imagined national community and presents some suggestions for thinking about this invention. For this author, one of the main interests in the study of national identities is because it is one of the most important sources of cultural identity in our era of modern states. "These identities are not literally imprinted on our genes. However, we effectively think of them as if they were part of our essential nature" (HALL, 2019, p. 29). The problem posed by this author is whether the idea of the nation-state really has an immutable identity. This is because, as we have pointed out, these institutions seem to be shaped by the product of language; stiffening within the Circumstances of Discourses, as Charaudeau (2016) would say. National cultures are a distinctively modern form. The loyalty and identification that, in a pre-modern era or in more traditional societies, were given to the tribe, the people, the religion and the region, was gradually transferred, in Western societies, to the national culture. Regional and ethnic differences were gradually being placed, in a subordinate way, under what Gellner calls the "political ceiling" of the nation-state, which thus became a powerful source of meaning for modern cultural identities. (HALL, 2019, p. 30, emphasis added). Thus, the observation undertaken in favor of a linguistically constructed idea of nation, as Anderson (2008) showed, seems to be directly linked to the abject marginalization of its supposed excess. This signaling highlights the representative character of a culture that subordinates and seeks to maintain difference as something of the past. When Hall (2019) states that identities, their processes of meaning and loyalty, as modes of adherence to a given culture, were transmuted into elements of a territory, at the

same time that they caused shifts that changed the way of conceiving the notion of subjects and belonging to a different place, they similarly altered individual cultural identities, especially of those who find their recognition undermined by a Ceiling Culture. This conception is a master key in Anderson's (2008) thought, as has been elucidated. These authors agree that a supposed generalizing identity entails harm to what Anderson calls poor cousins, and Hall (2019, p. 30) calls "regional and ethnic differences". In this context, this author asserts that, due to these unequal formation processes of a national community, it unleashed the culture of a unified language that hegemonically imposed itself on everyone who is under its respective roof, subordinating other cultural manifestations. Assuming that there is a single and exclusive national cultural identity, an attempt was made to develop mechanisms that could organize its structure and provide them with support. Some of these elements are: national literacy standards; a single national language of reference; and industrial production processes (HALL, 2019). Among several other symbolic resources for the representation of his imagination, there is the strategy of a national education system. All these and many other aids make up their complexion. At least in real Brazil, it seems that education and its Ministry are doing badly, in less than two years of the current political administration's mandate, beginning on January 1, 2019, they have already been invited to withdraw at least two from the minister's portfolio. of education. Paraphrasing Laferrière (2011), thinking about a dreamed Brazil now is the same as saying that we are bewitched without the spirit, a desolate country that finds itself living in a deep sleep; in a dementia, which in the Covid-19 pandemic prelude illusory ways of conducting education are devised; this one, equally, goes through a pandemic of lack of discernment, Fanon (2008) would say, so necessary to the cultural precepts of a people, being carried away by zombies. We would say, asking permission once again, that the education folder fell into the hole dug by Vilela's character (2016) and seems to stay there. Of course it is necessary another subject, decentered, to enter this hole and resume the educational project. We think that, when this happens, a post-critical multiculturalism (SILVA, 2020) in its hybridity will be the background. This Bachelard daydream exercise allows us to understand how the nationalist fantasy has found itself in contradictions, which surreptitiously ignore the capacity of individuals to guide themselves, following their own convictions, here ethics are imputed to themselves and to the other. The possibility of seeing the situation in these terms is also the condition of being able to argue that the imagined national community is a dated narrative (HALL, 2019). Therefore, other stories can be sutured. "A national

culture is a discourse – a way of constructing meanings that influences and organizes both our actions and our conception of ourselves” (HALL, 2019, p. 31). That's not just anything when we dwell on a supposed immutable identity that must serve in all spirits born under the same spectrum. This author, reflecting on how a nation is narrated, or imagined, presents some considerations. First, there is a narrative of the nation told and retold in a thousand and one way through literature, images, films, cinema, music, school, curricula. Thus, through the most diverse symbols and rituals, a feeling of national identity that represents a certain belonging is strengthened. The media, shared disasters, and a whole range of information on wins and losses are offered to us as possibilities to make sense of our individual experience. A second aspect that Hall (2019) presents is the emphasis on origins, continuity, tradition, and timelessness. In this perception, it is understood that the nation has its own characteristics, it has an immutable nature that is above contingencies. In a way, it is asleep, but it is always ready to be awakened. It's that feeling of eternal continuity that will always be somewhere in your primordial core. In Brazil, this discourse has been frequent, especially in the political sphere. There is a third element that makes up the author's questioning, and it corresponds to the invention of tradition. This discursive strategy builds the idea that there is an ancient tradition that, according to Hall, is often quite recent, in the case we have presented here, much of our thinking is from the 17th and 18th century with the Enlightenment, if we consider the history of thought. human is not that old. Such a tradition is inculcated in us through the invention of a set of values and practices, which are repeated as often as necessary, to make us believe in a certain continuity with an adequate past. A fourth feature of the national narrative concerns a supposed foundational myth. The narratives that are told based on this principle are linked to the national history, of a people with a distant past, within a time impossible to be reached within real time, but in a mythical time. According to Hall (2019, p. 33), these myths “provide a narrative through which an alternative story or a counter-narrative is told”. There are clear examples, in the context of beliefs and religiosities. The fifth image in the imagery of the national narrative is the one that represents a pure, original people or “folk”. As stated by Hall (2019, p. 33), “[...] in the realities of national development it is rarely this primordial people [folk] who persist or who exercise power”. The author seems to make it clear that these people who seek purification are not always the same people who dominate bureaucracy and power. It's much more of a myth that wrestles between the secular and the sacred. These resources that configure the invention of a

fundamental discourse are not that modern, but they have always been used in a sliding movement between a distant past and a present. At the same time that this type of argument seeks to justify a firm and validated basis, it intends to drive forward. It calls individuals to purify from an adequate source, and for this it mobilizes itself, especially against the threat of the other. “[...] Often this same return to the past hides a struggle [...] to expel the 'others' who threaten their identity and to prepare for a new march forward” (HALL, 2019, p 33). Based on these five characteristics, among others that make up the body of the discourse of a national identity culture, Hall (2019) presents us with at least three factors that aim to dispel this narrative, or show that it is not so unified. As we have shown previously, Anderson (2008), in his terms, refers to an imagined community. The uniqueness of national cultures, which act as sources of identity identification, is called into question. When analyzing the discursive structure of national identity, it is necessary to take into account the interest of the imagined community in preserving the memories of the past; the desire of individuals to live together; and the perpetuation of cultural heritage. The narrative of national identity represents the possibility of becoming a member of a nation-state, as well as identification through a national culture. Considering these factors, the author adds that “[...] no matter how different its members may be in terms of class, gender or race, a national culture seeks to unify them into a cultural identity, to represent them all as belonging to the same and large national family” (HALL, 2019, p. 35). The question of whether the national identity is really unifying and canceling out cultural diversity is pertinent. Namely, according to Hall (2019), a national culture was never a simple point of agreement and loyalty, but was always intertwined with structural issues of cultural power. What we pointed out before reveals this situation. In this regard, three observations made by the same author are pertinent. First, most modern nations are made up of separate cultures that have only been unified through violent processes. Second, nations are always composed of different social classes, gender groups, ethnicities and highly gendered. And third, modern nations were neo-imperial centers, exerting influences on the diversity of colonized cultures. “Modern nations are all cultural hybrids” (HALL, 2019, for. 36, emphasis added). In these terms, we should think of modern nations not as unified identities, but as discursive devices, which seek to represent difference through unity (BHABHA, 1998; WOODWARD, 2014; HALL, 2014, 2019).

### III. CONCLUSION

The research focused on the issue of nationalist discourse and its consequences on microcultural manifestations. It is in fact a theme that has gained space in different arenas, regarding identities and differences. In this context, the deep power relations that, while seeking to qualify the debate, find their limits in the processes of uniqueness invented by nationalist discourses are considered. Thus, all the questions considered were condensed into the following problem: what are the processes that configure the identity of an imagined community? Based on this problem, we set out to discuss the constitutive processes of an imagined community and its influence on microcultures. The results showed that there is a dynamic field of study in constant debate about identity and difference. On the one hand there are the pretensions of a nationalist conception that seeks to maintain the unity of difference, on the other there are cultural groups in open opposition to this objective. The awareness of ethnic, gender and class differences has motivated the decentering of the intentions of these imagined communities. According to the data, these communities are nothing more than discursively constructed inventions. And that supposedly traditional thought seeks, in the most different ways, to disqualify the discourse of diversity in favor of a national culture. The maintenance and development of national cultures make use of the most distinct strategic disciplinary forms. They are manifested through literary processes, cinematographies, musical works, media in general, symbolic systems, and the most dissimilar social practices. In this way, the exclusion of the other is a matter of the first order. There is no space, in the context of a nation's cultural identity, for expression, justified in the canons of unilaterally validated narratives. We found at least five ways to argue about the supposed identity of the nation. First, a narrative is invented, disseminated in the techniques already presented. Second, it is based on supposed origins, traditions, and timeless continuities. Third, traditions are invented, which are usually nothing more than contemporary events. Fourth, they seek to stick to the foundational myth argument, conditions that are beyond secular experience. And fifth, they build arguments based on the supposed puritanisms of an original people [folk]. These basic explanations have generally supported the monolithic arguments for the nation's identity. As alternatives to these discourses – which are based on memory, desire, and heritage – in this research we present three conditions that allow us to decenter these inventions. First, modern nations are formed by different cultures, which only at discriminatory cost, exclusion and violence were unified into a Ceiling Culture. Second, nations are always made up of different ethnic groups, genders, and

different social classes. And third, modern nations are neo-imperial centers that maintain influences on cultural differences. Finally, the nation, being a discourse, needs to be debated, studied, in order to know its psychology and counter-argument its discriminatory manifestations and forms. This is one of the main limits found by alternative narratives. However, the inferences presented indicate that the arenas are in activity. This grants legitimacy to the problem and possibilities to think about a society in which cultural difference can have space for expression. Perhaps a multicultural school curriculum, with a hybrid subject concept, in the near future we can glimpse the political/social acceptance of difference – violently, today, challenged to unity.

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# Environmental Related Disputes on Trade Issues in GATT and WTO from 1982-2002

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**Keywords**— GATT, WTO, UNEP, UNCTAD.

**Abstract**— *The General Agreement on Tariff and Trade/World Organization (GATT/WTO) is perceived as one of the few multilateral institutions dealing with trade and environment issues that has the means to settle trade-related environmental disputes unlike, for example, United Nations Environmental Program, (UNEP), United Nations Conference on Trade and Development (UNCTAD) or the Commission on Sustainable Development. In the light of this, many perceive the GATT/WTO as the institution that will eventually deal with and resolve trade and environment issues. The paper took a bird's eye view of the WTO Dispute Settlement Mechanism (DSM) on the environmental issues. It seeks to evaluate how far GATT/WTO provisions aid in settlement of environmental related disputes on trade issues by highlights the efficacy and the benefits of the DSM and its importance as a tool for developing countries to defend their interests when nullified or impaired by other Members, in particular developed country Members, while identifying the difficulties faced. The fact that WTO cannot adequately provide an equal solution to environmental trade disputes, expectations from environmentalists may often be too high. The WTO Secretariat itself emphasizes "that the WTO is not fully environmental protection agency. This has raised contradiction under the organization which this paper intends to investigate. To achieve this objective and to deal with research problem, we undertook desk research in libraries, relevant documentation centers, and internet website which enable to review existing literature on the question. The findings reveal that even though some of the WTO provisions are competence for policy coordination in this area is limited to trade policies, and those trade-related aspects of environmental policies which may result in a significant effect on trade, but it is grossly lacking at the level of settlement of environmental related disputes on trade issues.*

## I. INTRODUCTION

Environmental issues began to be systematically addressed in the WTO following the Decision on Trade and Environment taken towards the end of the Uruguay Round at Marrakesh in 1994. The Committee on Trade and Environment was established in the same year, with

the explicit mandate to resolve environmental related dispute in the trading system. Some new agreements under the WTO also contained environmental provisions. In 2001 the environment was explicitly put on the negotiating agenda in the Doha Ministerial Declaration (DMD). Today the environment has been mainstreamed into the multilateral trading system, and has significant

implications for shaping future rules under the WTO regime.<sup>1</sup> This paper gives an overview of settlement of the environmental related disputes on trade issues within the confine of GATT/WTO provisions. Here, the question pose goes thus, when are restrictive trade measures on environmental grounds justifiable under the GATT Article XX exceptions and in particular, how has the GATT Article XX been interpreted in environmental trade disputes? To better answer this question it will be interesting to examine the following aspects. An Overview of the WTO Dispute Settlement Mechanism, A review of environmental disputes related to trade issues in GATT/WTO, WTO Jurisprudence in Environmental Trade Disputes.

## II. AN OVERVIEW OF THE WTO DISPUTE SETTLEMENT MECHANISM

A WTO Member having a reasonable complaint against another Member concerning the rights and obligations in the WTO Agreements can avail itself of the Dispute Settlement Process of the WTO. This is contained in the Understanding on Rules and Procedures Governing the Settlement of Disputes. Dispute Settlement Understanding (DSU) is administered by the Dispute Settlement Body (DSB), which consists of the Members of the WTO. The DSB has the sole authority to establish "panels" of experts to consider the case, and to accept or reject the findings of the panels as well as the results of an appeal. It monitors the implementation of the rulings and recommendations, and in accordance with the procedures set up in Article 2.2, it has the power to authorize retaliation when a country does not comply with a ruling.<sup>2</sup>

Dispute settlement in the WTO plays a crucial role in providing security and predictability to the WTO multilateral trading system, in particular for developing countries. The Dispute Settlement system is in many ways the central pillar of the multilateral trading system and the WTO's most individual contribution to the stability of the global economy. The new WTO system is at once stronger, more automatic and more credible than its GATT predecessor. This is reflected in the increased diversity of countries using it and in the tendency to resolve cases "out of court" before they get to the final decision.<sup>3</sup>

The effectiveness and dependability of dispute resolution is key to the effective functioning of the WTO and ensures a number of benefits that are of particular importance for the weaker trading partners. It provides the WTO with a rule-oriented system that favours mutually agreed solutions and one that intends to secure withdrawal of inconsistent measures. The application of Dispute Settlement (DS) in the WTO rests on the following three main principles:<sup>4</sup>

- multilateralism versus unilateralism;
- exclusive application of WTO rules on dispute settlement to disputes related to the WTO; and
- uniform application to all WTO Agreements

The function of the DS is to preserve the rights and obligations of WTO Members. Without a means of settling disputes, the rules-based system of the WTO would not be as efficient because there would be no way of enforcing the rules and the weaker trading partners would have no way of making sure that their interests are protected.

The system is based on clearly defined rules, with schedules for completing a case. In addition, the countries can settle their dispute bilaterally at any stage. At all stages, the WTO Director-General is available to offer his good offices, to mediate or to help achieve a conciliation. The main stages of dispute settlement in the WTO are described below.

### 1.1. Consultation Phase

- A Member which feels aggrieved by the action of another will propose to hold consultation with the other Party. The latter has to respond within 10 days and enter into consultation within 30 days.
- If the consultation takes place, the Members should try to reach a satisfactory solution of the issues involved.
- If any other Member feels that it has a substantial trade interest in the matter in dispute, it may request to join the consultation.
- If the dispute has not been settled in 60 days the aggrieved party may ask for the formulation of a panel.

<sup>1</sup>Jha V. and R. Vossenaar, 2000. "Mainstreaming environment in the WTO: Possible implications for developing countries. Paper prepared for the UNCTAD/FIELD Project on Strengthening Research and Policy-Making Capacity on Trade and Environment in Developing Countries (Project INT/98/A61).

<sup>2</sup> Trade and Environment in the Multilateral Trading System Module 2, Train for trade 2000.

<sup>3</sup> Blackhurst, R. 1995. "Alternative Motivations for Including Trade Provisions in Multilateral Environmental

Agreements". *Schweizerische Zeitschrift für Volkswirtschaft und Statistik*. Vol. 131, No.3.

<sup>4</sup> Hudec, R. 1996. "The GATT/WTO Dispute Settlement Process: Can it Reconcile Trade Rules and Environmental Needs?" in R. Wolfrum. (ed.). *Enforcing Environmental Standards: Economic Mechanisms as Viable Means?* SpringerVerlag.

- In many instances, disputes have been resolved at the consultation stage, without further proceedings.

### 1.2. Panel and Appellate Body Review

- The DSB has to establish a Panel promptly.
- The DSB will prescribe the terms of reference of the panel. Usually standard terms of reference are used but in some cases and the special terms of reference are used in all cases. It calls for an examination of the issue raised by the complainant and the giving of findings to assist the DSB in making recommendations or in giving the rulings provided for in the relevant agreement.
- Normally a Panel consists of three members. Usually panel members are chosen from a list maintained for this purpose. The list consists of persons who have acquired direct experience in the field of GATT/WTO or have served as senior trade officials of Members or have taught or published on international trade law or policy. Nomination is initially proposed by the secretariat.

### 1.3. Adoption of the Report by the DSB

- Within 60 days of the sending of the panel report to the Members, the report must be adopted by the DSB unless one of the parties notifies its decision to go for appeal. In this case it will be considered by the Appellate Body which will give its decision normally within 60 days.
- The Appellate Body has seven members. Three members of this body serve on any one case.

### 1.4. Implementation

- It is expected that the Member to whom the recommendation for action has been addressed will implement the recommendation promptly. Within 30 days of the adoption of the Panel or Appellate Body report, the Member must inform the DSB about its intention in respect of the recommendations, including a time-table for implementation

### 1.5. Compensation and suspension of concessions

- If the recommendations have not been implemented within the time frame set for this purpose, the complaining party may either seek compensation or seek permission to withdraw or suspend concessions to the offending party.

## III. A REVIEW OF ENVIRONMENTAL DISPUTES RELATED TO TRADE ISSUES IN GATT/WTO

Under the GATT six panel proceedings on cases involving environmental measures or human health-related measures under Article XX were completed. Out of the six reports, only three were adopted. Under the WTO Dispute Settlement Understanding (DSU), four trade-related environmental disputes have been completed. It is important to note, that dispute settlement rulings concerning trade-related environmental measures or human health-related measures under Article XX (b) or (g)<sup>5</sup> have evolved considerably from the “tuna-dolphin” panel decisions under GATT to the latest dispute settlement rulings under the WTO. What is important in the WTO’s rules is that measures taken to protect the environment must not be unfair. In short, they must not discriminate between domestic and foreign products nor can they discriminate between different trading partners. The real challenge is to prove that measures are taken for legitimate environmental purposes and that they meet the requirements of the Chapeau of Article XX in order for them to be considered legitimate.<sup>6</sup>

This section presents a factual overview of some of the most relevant environmental issues in trade-related environmental disputes in GATT/WTO which include Interpretation of the GATT Article XX in Environmental Trade Disputes, WTO Jurisprudence in Environmental Trade Disputes and Food Safety Trade Disputes under the WTO.

### 2.1. Interpretation of the GATT Article XX in Environmental Trade Disputes

GATT Article XX general exceptions to free trade contain the first environmental provisions of the multilateral trading system. The exceptions contained in paragraphs (b), (d) and (g) of the article have been invoked in trade disputes related to the protection of the health and environment. The Article XX states that so long as trade measures applied are not arbitrary or unjustifiably discriminatory between countries or a “disguised restriction on international trade”, Members can adopt measures

(b) necessary to protect human, animal or plant life or health

<sup>5</sup> Article XX (b) and (g) are designed to allow WTO Members to adopt GATT-inconsistent policy measures if this is either “necessary” to protect human, animal or plant life or health, which together can be taken to mean “environment”, or if the measures relate to the conservation of exhaustible natural resources.

<sup>6</sup> Eglin, R. 1995. "Trade and Environment in the World Trade Organisation." World Economy. Vol. 18, No. 6.

(d) necessary to secure compliance with laws or regulations which are not inconsistent with the provisions of the Agreement

(g) relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption.

In the pre-WTO regime, as already mention above six trade disputes involved environmental/health-related measures under GATT Article XX exceptions. These disputes and the corresponding year of panel report adoption, include: (i) United State (US) – Taxes on Automobiles (1994, not adopted), (ii) US – Restrictions on Imports of Tuna from EEC also referred to as Tuna II (1994, but not adopted); (iii) US – Restrictions on Imports of Tuna from Mexico also referred to as Tuna I (1991, but not adopted)<sup>7</sup>, (iv) Thailand – Restrictions on Importation of and Internal Taxes on Cigarettes (1990), (v) Canada – Measures Affecting Exports of Unprocessed Herring and Salmon (1988), and (vi) US – Prohibition of Imports of Tuna and Tuna Products from Canada (1982),

Under the WTO, rulings have been made on three environmental trade disputes under GATT Article XX (food safety disputes being now covered separately under the sanitary phytosanitary Agreement (SPSA)). The three environmental disputes and the corresponding year of adoption of panel/ Appellate Body reports by the Dispute Settlement Board include:

(i) US – Standards for Reformulated and Conventional Gasoline also referred to as Reformulated Gasoline (1996); (ii) US – Import Prohibition of Certain Shrimp and Shrimp Products (1998) also referred to as Shrimp-Turtle; and (iii) EC – Measures Affecting Asbestos and Asbestos-Containing Products (2001).

A comparison of the environmental trade disputes in the pre- and post-WTO regimes illustrates a significant change in the interpretation of GATT Article XX provisions. This subsection briefly discusses the two pre-WTO environmental disputes of Tuna I and Tuna II; and the two post-WTO environmental disputes of Reformulated Gasoline and Shrimp-Turtle. All four of these disputes concerned trade restrictions invoked under GATT Article

XX exceptions for the protection of environment/exhaustible natural resources.<sup>8</sup>

### 2.1.1. Tuna I:

The Tuna I dispute in 1991 between the United States and Mexico, for the first time turned the focus on the question of GATT-consistency of Member nations following sovereign environmental policies and imposing the same on a trading partner. The US had imposed an embargo on imports of yellow-fin tuna and tuna products from Mexico, Venezuela and Vanuatu and from the intermediary countries of Costa Rica, France, Italy, Japan and Panama based on its domestic regulation, the Marine Mammal Protection Act (MMPA) of 1972 as amended. The MMPA prohibited the incidental killing or seriously injuring any marine mammal (beyond the US standard set<sup>9</sup>) in connection with the harvesting of fish within the jurisdiction of the US. Moreover, Section 101(a)(2) of the Act provided for a ban on importation of commercial fish or products from fish caught with commercial fishing technology which resulted in the incidental killing or incidental serious injury of ocean mammals in excess of United States standards. Thus the Act effectively set a ceiling limit on dolphin catches for American fishing fleet and for countries exporting to the US.<sup>10</sup>

Mexico complained against the US embargo on the grounds that the embargo was inconsistent with the GATT rules, like: that the provision under MMPA was inconsistent with Article III (National Treatment of traded products), the embargo was also not "necessary" in the sense of Article XX, and that Article XX (b) referred to protection of the life and health of humans and animals within the territory of the contracting Party protecting them. On the other hand, the US argued that the GATT's National Treatment provision permitted the enforcement of dolphin protection standards set out in the MMPA, and the import embargo was justified under Article XX exception clauses to protect animal health or exhaustible natural resources.<sup>11</sup>

The Dispute Panel noted that the US embargo was not covered under GATT Article III, since the latter "covers only those measures that are applied to the product as such", and regulations on incidental killing/ injury to

<sup>8</sup> APARNA SAWHNEY, "WTO-related matters in trade and environment: relationship between WTO rules and MEAS" May 2004.

<sup>9</sup> On an average, the vessel of harvesting nations could not take (incidental killing/ injury) more than 15% of eastern spinner dolphin and not more than 2% of coastal spotted dolphin as a proportion of the total number of marine mammals taken by such vessels in a year. (GATT 1994a).

<sup>10</sup> Ibid.

<sup>11</sup> Ibid.

<sup>7</sup> Unlike the system of decision making now contained in the Dispute Settlement Understanding of the WTO, in the GATT a panel report was not adopted if there was no consensus. Under the WTO, if the members do not by consensus reject a panel report after 60 days, it is automatically accepted or adopted.



dolphin “could not be regarded as being applied to tuna products as such because they would not directly regulate the sale of tuna and could not possibly affect tuna as a product” (GATT 1991). Under the principle of National Treatment, the US was obliged to treat Mexican tuna no less favourably than domestic tuna (the traded product), irrespective of the ways in which they may have been harvested since it did not impact tuna as a product. *This implied that non-product related process and production methods could not used as a basis of trade measures under the GATT.* The Panel ruling found that the US embargo was contrary to Article XI:1 (elimination of quantitative restrictions).

The Dispute Panel also ruled the import prohibition of Mexican tuna as unjustifiable under Article XX (b) or (g); and the import prohibition on “intermediary countries” unjustifiable under Article XX (b), (d) or (g). The Panel noted that while the provisions of the GATT did not restrain a contracting party in the implementation of domestic environmental policies, “a contracting party may not restrict imports of a product merely because it originates in a country with environmental policies different from its own” (emphasis added, GATT 1991). The Dispute Panel considered the Article XX exceptions to protect exhaustible natural resources (here dolphins) to be applicable only to natural resources lying within the jurisdiction of the government imposing the regulations.<sup>12</sup>

### 2.1.2. Tuna II

In 1992, the European Community (EC) and Netherlands complained that the US embargo against primary and intermediary countries, based on the MMPA, did not fall under Article III (National Treatment), was inconsistent with Article XI:1 (Elimination of Quantitative Restrictions) and was not covered by the exceptions of Article XX. The US argued that the intermediary nation embargo was consistent with GATT, covered by Article XX (b), (d) and (g), and that the primary nation embargo did not nullify or impair any benefits accruing to the EC or the Netherlands since it did not apply to these countries.<sup>13</sup>

On the jurisdictional issue of its action, the US argued that provisions under international environmental agreements allowed for import restrictions that did not necessarily restrict jurisdictional applicability. In particular, Article 3 of the Convention Relative to the Preservation of Fauna and Flora in their Natural State,

1933, allowed for the prohibition of products from intermediary countries unless otherwise certified. The US argued that while the Convention applied to hunting and killing within the parties' respective territories, the restrictions on importation required application to *activities beyond the territorial jurisdiction of the importing party*, and were designed to protect resources outside the importing party's jurisdiction (emphasis added). Equally, Article IX of the Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere (1940) provided for each contracting government to take the necessary measures to control and regulate the importation, exportation and transit of protected fauna and flora through an export certification system or the “prohibition of the importation of any species of fauna or flora or any part thereof protected by the country of origin unless accompanied by a certificate of lawful exportation”. Apart from these two Conventions the US also cited the provisions for import prohibitions under other MEAs: Article 3 of the International Convention for the Protection of Birds (1950); Article V of the Agreement on the Conservation of Polar Bears (1973); Article VIII:2 of the Convention on Conservation of North Pacific Fur Seals (1976); Article 3 of the Convention on the Prohibition of Fishing with Long Driftnets in the South Pacific (adopted 1989, but not yet in force). Two of these agreements, namely, the International Convention for the Protection of Birds and the Agreement on Conservation of Polar Bears, did not provide any jurisdictional limitation on the import and export prohibitions.<sup>14</sup>

In the light of Article 31 (general rule of interpretation) of the Vienna Convention on the Law of Treaties, the US interpreted that there was no jurisdictional limitation on the location of the resource or living thing in GATT Article XX (g) and (b). The Dispute Panel, however, pointed out that the Article 31 of the Vienna Convention refers to “any subsequent agreement between the parties regarding the interpretation of the treaty or the application of its provisions”, while the international agreements cited in the dispute were bilateral or plurilateral agreements that were not concluded among the contracting parties to the General Agreement. Thus these agreements did not apply to the interpretation of the General Agreement or the application of its provisions.<sup>15</sup>

<sup>14</sup> Ibid.

<sup>15</sup> The Panel also observed that under the general rule of interpretation in the Vienna Convention account should be taken of “any subsequent practice in the application of the treaty which established the agreement of the parties regarding its interpretation.” However, the Panel noted that practice under the bilateral and plurilateral treaties cited both the primary and intermediary nation embargoes on tuna were taken by the United States so as to force other countries to change their policies with

<sup>12</sup> Mattoo, A. and P. Mavroidis. 1996. “Trade, Environment and the WTO: How Real Is the Conflict?” in E.-U. Petersmann. (ed.). International Trade Law and the GATT/WTO Dispute Settlement System. Kluwer.

<sup>13</sup> Esty, D. 1994. Greening the GATT: Trade, Environment and the Future. Institute for International Economics, Washington, D.C.

In determining the necessity of the US measure for conservation of dolphins, the Panel concluded that measures taken to force other countries to change their policies, and which were effective only if such changes occurred, could not be considered "necessary" for the protection of animal life or health in the sense of Article XX (b). Thus an essential condition of Article XX (b) had not been met.<sup>16</sup> The Panel found that the import prohibitions on tuna and tuna products maintained by the United States inconsistent with Article XI:1 and not justified by Article XX (b).

The Dispute Panel noted that the objective of sustainable development, which includes the protection and preservation of the environment, is recognized by the contracting parties to the General Agreement. The Panel did not question the validity of the environmental objectives of the US to protect and conserve dolphins, but examined whether, in the pursuit of its environmental objectives, the US could impose trade embargoes to secure changes in the policies which other contracting parties pursued within their own jurisdiction. The Panel ruled that the US import prohibitions (both the primary and the intermediary nation embargo) on tuna and tuna products under the MMPA "did not meet the requirements of the GATT Article III, were contrary to Article XI:1, and were not covered by the exceptions in Article XX (b), (g) or (d)".

### 2.1.3. Reformulated Gasoline:

In January 1995, Venezuela, followed by Brazil, complained against US discrimination in import of gasoline under the latter's Gasoline Rule. The complainants argued that the US restriction was inconsistent with GATT Article III (National Treatment) and not covered by GATT Article XX exceptions. The US Gasoline Rule (based on the 1990 Amendment of the Clean Air Act)<sup>17</sup>, effective 1995, permitted only gasoline of a specified cleanliness (reformulated gasoline) to be sold to consumers in the most polluted areas of the country, while in the rest of the US, gasoline no dirtier than that sold in the base year of 1990 (conventional gasoline) could be sold.

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respect to persons and things within their own jurisdiction, since the embargoes required such changes in order to have any effect on the protection of the life or health of dolphins. (GATT 1994a)

<sup>16</sup> Ibid.

<sup>17</sup> The 1990 US Clean Air Act Amendment established certain compositional and performance specifications for reformulated gasoline, in order to reduce the emissions of volatile organic compounds and toxic air pollutants. The Rule established baselines (1990) for domestic refiners, and related baselines for blenders and importers of gasoline.

The Dispute Panel ruled that the US Gasoline Rule was inconsistent with Article III since imported and domestic gasoline should be considered as "like products". Moreover, the US action was not justified under the GATT Article XX paragraphs (b), (d) or (g). The US appealed on the Panel's findings on Article XX (g), and subsequently the Appellate Body found that the baseline establishment rules (for both domestic gasoline and imported gasoline) in the Gasoline Rule fell within the terms of Article XX (g). However, the Appellate Body ruled that the US application of the baseline rules constituted "unjustifiable discrimination" and a "disguised restriction on international trade... and not entitled to the justifying protection afforded by Article XX as a whole" (WTO 1996b: 30). According to the Appellate Body, the US action failed to meet the requirements of the chapeau of Article XX, since the US could have used alternative means to implement its Clean Air Act by "imposition of statutory baselines without differentiation as between domestic and imported gasoline" (WTO 1996b: 26).

The Appellate Body used the principle of interpretation based on Article 31.1 of the Vienna Convention on the Law of Treaties: "A treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose." (WTO 1996b: 17-24), and considered the objective of the Gasoline Rule (namely, to implement the US 1990 Clean Air Act) and GATT Article XX including its chapeau to interpret them. The Appellate Body, however, noted "two omissions on the part of the United States: to explore adequately means, including in particular cooperation with the governments of Venezuela and Brazil, of mitigating the administrative problems relied on as justification by the United States for rejecting individual baselines for foreign refiners; and to count the costs for foreign refiners that would result from the imposition of statutory baselines" (WTO 1996b: 30). Hence the US action was unjustifiable under Article XX.

Thus the first environmental trade dispute brought to the WTO affirmed that a Member (here the US) had the right to adopt the stringent environmental standards, provided the application of the regulation does not discriminate against foreign imports. "WTO Members have a large measure of autonomy to determine their own policies on the environment (including its relationship with trade), their environmental objectives and the environmental legislation they enact and implement." (emphasis added, WTO 1996b: 32). Moreover, if the Member could demonstrate cooperation with other Members towards the implementation of the regulation, such unilateral environmental legislation may be found

justifiability under GATT Article XX. In its final conclusion, the Appellate Body recalled the preamble to the WTO Agreement as well as the Decision on Trade and Environment, to emphasize the importance of cooperation and “of coordinating policies on trade and the environment.”<sup>18</sup>

#### 2.1.4. Shrimp-Turtle:

An amazingly similar dispute to the Tuna I case was brought to the WTO against the US in 1996. The US had banned shrimp imports from countries where the shrimp was harvested without Turtle Excluder Devices (hence killing too many Olive Ridley Turtles in the process) as required under its domestic legislation, the 1989 Public Law 101-162, Section 609. Malaysia and Thailand, followed by Pakistan and then India, complained that the import prohibition was inconsistent under Article I:1 (Most Favoured Nation), Article XI:1 (Elimination of Quantitative Restrictions), and Article XIII:1 (Restrictions to Safeguard Balance of Payments). The US justified its measure under Article XX (b) and (g), arguing that the provision did not constrain jurisdictional limitations nor the location of the natural resources/ animals to be protected and conserved.<sup>19</sup>

In 1997, the Dispute Panel ruled in favour of the complainants, and found that the import ban in shrimp and shrimp products as applied by the United States was inconsistent with Article XI:1 of GATT 1994, and unjustifiable under Article XX of GATT. After the US appeal on the Panel’s interpretation, in 1998 the Appellate Body also found the US unilateral action unjustified, but reversed the Panel’s finding that the US measure at issue was not within the scope of measures permitted under the chapeau of Article XX of GATT 1994. The Appellate Body ruled that the US measure qualified for provisional justification under Article XX (g), but it failed to meet the requirements of the chapeau of Article XX since the measure was discriminatory, and therefore not justified under Article XX.<sup>20</sup>

The Appellate Body also clarified the meaning of exhaustible natural resources in Article XX to include renewable living resources, and indicated that the complainants had misinterpreted the term: “Textually, Article XX (g) is not limited to the conservation of ‘mineral’ or ‘non-living’ natural resources. The complainants’ principal argument is rooted in the notion

that ‘living’ natural resources are ‘renewable’ and therefore cannot be exhaustible natural resources. We do not believe that ‘exhaustible’ natural resources and ‘renewable’ natural resources are mutually exclusive. One lesson that modern biological sciences teach us is that living species, though in principle, capable of reproduction and, in that sense ‘renewable’, are in certain circumstances indeed susceptible of depletion, exhaustion and extinction, frequently because of human activities.” (WTO 1998: paragraph 128).<sup>21</sup>

Moreover, the Appellate Body reiterated the Preamble of the WTO Agreement, which states that the optimal use of natural resources should be in accordance with sustainable development. The Appellate Body indicated that the language of the Preamble allowed for a wider interpretation of the WTO provisions and agreements, based on the “intentions” of the WTO negotiators to acknowledge the environmental dimensions into the multilateral trading system:

*“(the) language demonstrates a recognition by WTO negotiators that optimal use of the world’s resources should be made in accordance with the objective of sustainable development. As this preambular language reflects the intentions of negotiators of the WTO Agreement, we believe it must add colour, texture and shading to our interpretation of the agreements annexed to the WTO Agreement, in this case, the GATT 1994. We have already observed that Article XX(g) of the GATT 1994 is appropriately read with the perspective embodied in the ... preamble.”*

(WTO 1998, paragraph 153)

The Appellate Body Report noted the intent of the international community to protect environmental resources and made several references to international conventions. More significantly, the Appellate Body observed that the WTO agreements should not be viewed in “clinical isolation” from other rules of international law, including treaties.<sup>22</sup> In particular, the Olive Ridley sea turtle was listed under species threatened with extinction in Appendix 1 of the CITES, and also as a migratory species in Annex I of the Convention on the Conservation of Migratory Species of Wild Animals. The references were made to illustrate that the sea turtle should be considered

<sup>18</sup> GATT. 1994. The Results of the Uruguay Round of Multilateral Trade Negotiations. GATT Secretariat, Geneva.

<sup>19</sup> Ibid.

<sup>20</sup> Report of the Appellate Body, “US- Import Prohibition of Certain Shrimp and Shrimp Products” (AB1998-4), WT/DS58/AB/R, dated 12 October 1998: pages 75-76.

<sup>21</sup> Ibid.

<sup>22</sup> This approach was evident in the ruling of the US – Gasoline (1996) dispute too. As will be seen later in Section 4, this has been quoted by the EC in its submission on current negotiations on trade measures pursuant to MEAs to highlight the true interpretation of WTO rules.

as “exhaustible natural resources”, as well as the international community’s efforts to conserve this resource. In this dispute, however, the traded product was shrimp (not an endangered species) and not the endangered turtles, thus the CITES (ratified by both India and the US) did not apply.<sup>23</sup>

The final ruling by the Appellate Body upheld the principle of cooperation to protect global environmental resources as contained in the Multilateral Environmental Agreements (MEAs) like the Convention on Biological Diversity and the Convention on the Conservation of Migratory Species of Wild Animals; as well as the Rio principle of the avoidance of protectionist trade measures, and the adherence to effective multilateral disciplines to ensure responsiveness of the multilateral trading system to environmental objectives (WTO 1998, paragraph 154). The Appellate Body also recalled Article 3.2 of the WTO Dispute Settlement Understanding, under which the WTO agreements are to be interpreted in accordance with “customary rules of interpretation of public international law”. Since MEAs are international treaties, they form part of the international law, and bear on the settlement of environmental trade disputes under the WTO.<sup>24</sup>

The environmental provisions under the GATT/WTO were interpreted with reference to “sustainable development” in the Preamble and in a wider context of the “intentions of negotiators of the WTO Agreement”<sup>25</sup>. The US unilateral ban on shrimp was found unjustifiable for much the same reason as in the Gasoline dispute – lack of cooperative efforts before resorting to trade measures to protect the environment. In this case, the US had failed to engage in any concerted bilateral or multilateral effort to conserve the sea turtles:

“Another aspect of the application of Section 609 that bears heavily in any appraisal of justifiable or unjustifiable discrimination is the failure of the United States to engage the appellees, as well as other Members exporting shrimp to the United States, in serious, across-the-board negotiations with the objective of concluding bilateral or multilateral agreements for the protection and conservation of sea turtles, before enforcing the import prohibition against the shrimp exports of those other Members”

(WTO 1998: paragraph 166)

<sup>23</sup> Ibid.

<sup>24</sup> Anderson, K. 1995. The Multilateral Trading System and Sustainable Development. Policy discussion paper 95/08, Centre for International Economic Studies, University of Adelaide, Adelaide.

<sup>25</sup> Ibid.

This suggested that in case the US engaged in bilateral or multilateral environmental agreements to protect the sea turtle in question, the unilateral measure would be justified.

Not surprisingly, in the 2001 dispute on the Compliance panel report, after Malaysia took recourse to Article 21.5 (Understanding of Rules and Procedures Governing the Settlement of Dispute) of the DSU and appealed on the grounds of dissatisfaction with US action, the US was found to be justified in its action. By this time, the US had demonstrated good faith efforts by negotiating a Memorandum of Understanding with certain countries in the Indian Ocean and South-East Asia region (the South-East Asian MOU) that took effect on 1 September 2001” (WTO 2001: 50). The 2001 ruling clearly established that a WTO Member with demonstrable cooperative efforts to protect the environment with its trade partners is justified in unilateral trade restrictions under GATT Article XX. Thus Barfield (2001) observed that the Shrimp-Turtle dispute set forth an “evolutionary interpretation of unilateralism”.

#### 2.1.5. Food Safety Trade Disputes under the WTO

Four food safety-related trade disputes have been settled under the WTO including: (i) Australia – Measures Affecting Importation of Salmon (1998); (ii) EC – Measures Concerning Meat and Meat Products (Hormones) (1998); (iii) EC – Measures Affecting Livestock and Meat (Hormones) (1998); (iv) Japan – Measures Affecting Agricultural Products (1999).<sup>26</sup> All the health and safety-related trade disputes settled under the WTO have involved developed countries. The issue at stake in all the disputes was the use of restrictive sanitary measures based on precaution without appropriate risk assessment and/or scientific evidence.

In the first dispute of Australia’s prohibition of imports of salmon from Canada based on a quarantine regulation, in 1995 Canada alleged that the prohibition was inconsistent with GATT and the Agreement on Application of Sanitary and Phytosanitary Measures (SPS Agreement). The Dispute Panel found that Australia’s measures were inconsistent with certain provisions of the SPS Agreement. After Australia’s appeal on the Panel’s interpretation, the Appellate Body ruled that the Australian prohibition was inconsistent with Articles 5.1 (risk assessment), 5.5 (non-discrimination), 2.2 (scientific evidence) and 2.3 (non trade-restrictive) of the SPS Agreement. Moreover, the Appellate Body reversed the Panel’s finding that Australia

<sup>26</sup> Anderson, K. and A. Strutt. 1994. On Measuring the Environmental Impacts of Agricultural Trade Liberalization. Seminar Paper 94-06, Centre for International Economic Studies, University of Adelaide, Adelaide.

had acted inconsistently with Article 5.6 of the SPS Agreement, since factual evidence was insufficient to support such a conclusion.<sup>27</sup>

In the case of Japanese restrictions on agricultural products, the US alleged violations under provisions of the SPS Agreement, GATT 1994, and the Agreement on Agriculture. The Dispute Panel found that Japan acted inconsistently with Articles 2.2 and 5.6 of the SPS Agreement, and Annex B and, consequently, Article 7 (transparency) of the SPS Agreement. Following Japan's appeal on the Panel's interpretation of certain law, the Appellate Body upheld the basic finding that Japan's varietal testing of apples, cherries, nectarines and walnuts is inconsistent with the requirements of the SPS Agreement.

The two disputes on the use of hormones are especially relevant in relation to a recent multilateral environmental agreement, the Cartagena Protocol on Biosafety, considering hormone fed cattle as Living Modified Organisms (LMOs). In the first meat hormone dispute in 1996, the US complained that the measures taken by the EC under the "Council Directive Prohibiting the Use in Livestock Farming of Certain Substances Having a Hormonal Action" to restrict imports of meat and meat products were inconsistent with provisions under GATT 1994, SPS Agreement, TBT Agreement and the Agreement on Agriculture. Similarly, in the second meat-hormones dispute, Canada complained that the EC ban on importation of livestock and meat from livestock treated with certain substances having a hormonal action violated provisions under the SPS; GATT; TBT; and Agreement on Agriculture.<sup>28</sup>

The final dispute ruling for the two cases found that the EC import prohibition on beef from cattle raised on growth hormone was inconsistent with Articles 3.3 (scientific justification for more stringent standards) and 5.1 (risk assessment) of the SPS Agreement.<sup>29</sup> The Appellate Body noted that studies on the specific hormones in question failed to show how their use in growth promotion would result in hormone residue in beef and the associated health risks. Moreover, the Appellate Body (as well as Panel) noted that the hormone ban was inconsistent with the Europeans Communities (EC)

practice of permitting the use of two known carcinogenic additives in feed for piglets.<sup>30</sup>

At the heart of the EC-hormone disputes was the issue of risk associated with the introduction and consumption of genetically or living modified organisms in an importing country. The Transboundary Movement of LMOs is now covered by the Cartagena Protocol on Biosafety (in force since September 2003), which has been ratified by the EC, but not the US or Canada. Under the Protocol, a Party may choose not to import even if scientific information is insufficient (emphasis added, Article 11.8).<sup>31</sup>

Food Safety Trade Disputes under the WTO. The provision in the Cartagena Protocol allowing import restriction with insufficient scientific information is potentially in conflict with the science-based provision in the SPS Agreement. Article 5.7 of the SPS Agreement allows a Member to apply a measure only on a provisional basis in case of insufficient scientific information, and a Member is expected to review such measures "within a reasonable period of time". Considering the long-standing difference between the United State (US) and EC on the issue of living/genetically modified organisms, the interpretative decision pursuant to the negotiations under Dutch Muscular Dystrophy (DMD) Para 31 (i) will have a major bearing on trade disputes of this nature. It should be noted, however, that the Doha Declaration contains a condition, stating negotiations on the clarification of relationship between trade measures in MEAs and WTO rules should not disturb the rights of the WTO Members especially under the Agreement on Application of Sanitary and Phytosanitary Measures. In other words, Article 11.8 of the Cartagena Protocol should not disturb the rights of a WTO Member like the US (non- Party to the Protocol), as per Article 5.7 of the Agreement on Application of Sanitary and Phytosanitary Measures. The clause in the DMD safeguards the US commercial interests against the provisions of the Cartagena Protocol, since the US remains the foremost proponent of research and practice of genetically modified crops and livestock.

#### IV. WTO JURISPRUDENCE IN ENVIRONMENTAL TRADE DISPUTES

The GATT Article XX exceptions on environmental grounds have so far provided ample room for departures from free trade, and its interpretation over

<sup>27</sup> Charnovitz S. 1999. "Improving the Agreement on Sanitary and Phytosanitary Standards", in Gary P. Sampson and Bradnee W. Chambers, editors, Trade, Environment and the Millennium, United Nations University Press.

<sup>28</sup> Consumer Unity and Trust Society (CUTS). 1997. Non-Tariff Barriers or Disguised Protectionism. Briefing paper No. 2. Calcutta.

<sup>29</sup> Update of WTO Dispute Settlement Cases (WT/DS/OV/160), dated 17 October 2003: page 60-61.

<sup>30</sup> This differential treatment, according to the US and Canada demonstrated the protectionist nature of the ban, to take care of the condition of the EU market for meats. (Kelly 2003).

<sup>31</sup> See section 3.1 for a brief description of the Cartagena Protocol on Biosafety.

the last decade has expanded considerably (comparing the Tuna I analysis with that of the Shrimp-Turtle). Several changes are significant.

First, in the pre-WTO regime, process and production methods unrelated to the product (e.g. incidental kill of dolphin during tuna harvest) was a matter of consideration, however, in the post-WTO Shrimp-Turtle dispute, the distinction between product-related or non-product-related production process was of no consequence. This probably reflected the cognizance of the total environmental impact of a product from cradle to grave – i.e. the aggregate environmental resource cost, irrespective of the fact whether it affects the final product characteristics or not.

Second, and more importantly, the extra-jurisdictional aspect of a Member country imposing domestic environmental regulation on its trading partner did not arise in the post WTO environmental disputes. In the Tuna I case, the Dispute Panel had categorically noted that *a contracting party may not restrict imports of a product merely because it originates in a country with environmental policies different from its own*, and Article XX exceptions were interpreted to apply only to environmental resources *within the Member country's jurisdiction*. In the Appellate Body rulings of the Gasoline and Shrimp-Turtle<sup>32</sup> disputes, however, the extra-jurisdictional aspect of similar unilateral action was not an issue, and the focus was on the depletable/ exhaustible nature of the environmental resources in question, namely, air and turtles respectively. While this new jurisprudence is appropriate from the ecological perspective, there is a risk of the same logic being extended to differential environmental regulations for local pollutants in future disputes, since Members have autonomy to a large degree in determining their own environmental policies.

Both in the Gasoline and the Shrimp-Turtle disputes, the issue of extra jurisdictional imposition of environmental standards/ regulations was disregarded, and the focus was turned on whether the US had engaged in any cooperative efforts before resorting to the unilateral trade sanction. In the Gasoline case, the Appellate Body also noted that the cost of compliance with the American standards by foreign countries had been neglected. Thus both rulings provided a clear avenue for *justifiable*

unilateral trade sanctions in case the US could demonstrate its good faith efforts in environmental protection cooperatively with the trading Member prior to the unilateral action. Since the 2001 Shrimp-Turtle Compliance dispute was ruled in favour of the US in recognition of such good faith effort, it is likely that a trade restriction pursuant to a MEA is likely to survive a potential WTO-challenge. After all an MEA is a *good faith* multilateral effort, and multilateral actions are generally preferred to unilateral action under the WTO system.<sup>33</sup>

Third, in the post-WTO disputes, the environmental provisions under the GATT/WTO system have been “interpreted in good faith” and “in the light of its object and purpose” (Article 31.1, Vienna Convention on the Law of Treaties). In future the GATT Article XX exceptions will continue to be interpreted in the wider context since “context for the purpose of the interpretation of a treaty shall comprise, in addition to the text, including its preamble and annexes... any agreement... or instrument” among the parties (Article 31.2, Vienna Convention), and not in the narrow context used in the Tuna I dispute. The Appellate Body analysis of the recent disputes recognized the “intentions of negotiators of the WTO Agreement”, and gave due regard to the international community’s efforts to conserve the environment, including MEAs. This suggests that even if no new environmental provisions are negotiated under the WTO, the existing commitment to support “sustainable development” and “protect and preserve the environment”, as stated in the Preamble, is sufficient for the multilateral trading system to acknowledge and support contemporary environmental initiatives of the international community.<sup>34</sup>

This argument could be even extended to suggest that the WTO would acknowledge and support new MEAs even if not all of its Members are party to the new treaty. While a new treaty cannot create rights and obligations for a third party without its consent (Article 34, Vienna Convention), there is provision for rules in a treaty to become binding on a third party through international custom (“as a customary rule of international law, recognized as such”) under Article 38 of the Vienna Convention.

Also, the jurisprudence in the interpretation of GATT Article XX in the environmental trade disputes under the WTO is significant since it comes under the

<sup>32</sup> In the Shrimp-Turtle dispute, the Appellate Body noted that: “We do not pass upon the question of whether there is an implied jurisdictional limitation in Article XX(g), and if so, the nature or extent of that limitation. We note only that in the specific circumstances of the case before us, there is a sufficient nexus between the migratory and endangered marine populations involved and the United States for purposes of Article XX(g).” (WTO 1998: paragraph 133).

<sup>33</sup> Brack D. 1999. “Environmental Treaties and Trade: Multilateral Environmental Agreements and the Multilateral Trading System”, in Gary P. Sampson and Bradnee W. Chambers, editors, Trade, Environment and the Millennium, United Nations University Press.

<sup>34</sup> Ibid.

category of “subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation” (Article 31.3 b, Vienna Convention), and has in effect established the meaning of exceptions under Article XX (b), (d), and (g). It is interesting to note that the two major WTO Members, namely the US and the EC, support and approve of the current jurisprudence of the WTO. In particular, the US has been and continues to be a proponent of a robust dispute settlement system in the WTO. Indeed the establishment of the WTO dispute settlement system, considered to be “one of the most significant changes adopted as a part of the Uruguay Round” was sought by the US Congress in the negotiations since it considered the GATT dispute settlement to be “ineffective”.<sup>35</sup> In 2002, the US Secretary of Commerce noted that an “effective dispute settlement system advantages the United States not only through the ability to secure the benefits negotiated under the agreements, but also by *encouraging the rule of law among nations*”.<sup>36</sup> The US had anticipated in its negotiations that the application of the DSU would “improve its ability to contest foreign trade remedy actions against U.S. exporters”. The US Secretary of Commerce’s assessment of the WTO dispute settlement system is that, overall the system has worked to the benefit of the U.S., providing a means to enforce U.S. rights and contributing to greater compliance by WTO Members. The United States has been able to successfully use (in several disputes where the US was the complainant) the WTO dispute settlement “to open markets for U.S. business; to preserve and create U.S. jobs; to eliminate trade distorting practices from the global marketplace; and to defend successfully U.S. laws and policies.”

Given these benefits accrued through the WTO dispute settlement system, the US will continue to support and actively use the system to enforce its domestic environmental standards unilaterally through the multilateral trading system, rather than be party to a multilateral environmental initiative. Indeed, whenever, domestic commercial interests are threatened, the US has refrained from being a party to a MEA. For instance, the US is not a party to the Basel Convention, nor the Cartagena Protocol on Biosafety, since it is one of the

largest exporters of hazardous wastes (covered under the Basel) and genetically modified products (covered under the Cartagena Protocol).

At the same time, the EC has been encouraged by the new jurisprudence in the environmental trade disputes under the WTO, since the approach adopted in resolving such cases “strongly suggests that the conclusion of an MEA could well be a key element to determine the justification of certain measures under Article XX of the GATT” (WTO 2002a). The EC particularly favours the Appellate Body observation (in the Gasoline dispute) that WTO rules should not be considered in “clinical isolation” of other international law and that Article XX must be interpreted “in light of contemporary concerns of the community of nations about the protection and conservation of the environment” has sanctified the acceptance of MEAs within the WTO system. Thus, while the EC is opposed to unilateralism (which US is prone to adopt), and remains a forceful proponent of multilateral consensus in using trade measures on environmental grounds, the wider interpretation of GATT Article XX exceptions in the recent disputes has appeal for both the trading giants.

## V. CONCLUSION

Even though some of the WTO provisions stand for settlement of the environmental related disputes on trade issues, something is still lacking as WTO is not an environmental protection agency, WTO Secretariat notes that “in addressing the link between trade and environment, [therefore] WTO Members do not operate on the assumption that the WTO itself has the answer to environmental problems. However, they believe that trade and environmental policies can complement each other. Environmental protection preserves the natural resource base on which economic growth is premised, and trade liberalization leads to the economic growth needed for adequate environmental protection. To address this complementary, the WTO's role is to continue to liberalize trade, as well as to ensure that environmental policies do not act as obstacles to trade, and that trade rules do not stand in the way of adequate domestic environmental protection”. Clear international trade rules are needed for the protection, particularly for the economically weaker trading partners, against the unnecessary trade effects of environmental policies of trading partners. Without strong trade rules, protectionist measures may be applied under the guise of environmental protection policies.

Modifications in WTO rules that might make environment-related trade restrictions easier to the developing countries are needed. However, there is also a

<sup>35</sup> US Secretary of Commerce (2002). “The WTO Dispute Settlement Understanding achieved the objectives set out by the Congress by effecting important changes in the GATT 1947 dispute settlement process, including time limits for each stage of the dispute settlement process; appellate review; automatic adoption of panel or Appellate Body reports in the absence of a consensus to reject the report; and procedures to suspend trade concessions with any Member failing to implement Dispute Settlement Body (DSB) recommendations and rulings.”

<sup>36</sup> Emphasis added, *ibid*.

danger that if international trade rules are perceived to get in the way of increased environmental protection at the national and international levels, environmental policies will be adopted without regard for trade. For developing countries, the maximum safeguard is provided by a rule-based multilateral trading system which takes account of environmental concerns, rather than being exposed to the risk of unilateral trade measures. There is a need to carefully examine whether certain adjustments in the trade rules need to be made to better accommodate environmental policies while at the same time providing safeguards against unnecessary trade restrictions. The Committee on Trade and Environment is needed to make recommendations on whether any modifications of the provisions of the multilateral trading system are required, compatible with the open, equitable and non-discriminatory nature of the system. It did not make any such recommendation in its first report to the WTO Ministerial Conference in Singapore. It is worth noting that coordination between trade officials and environmental officials at the national level is of crucial importance in ensuring that the linkages and complementarities that exist between trade and environment policies are taken into consideration and are adequately addressed. How can we substantiate the fact that international trade has led to globalization of the economic system?

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# Agricultural Land Utilization for Beef Cattle Business Development in Kediri City

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**Keywords**—*Agricultural Land, Animal Feed, Mapping, Land Carrying Capacity, Carrying Capacity Index, Perception.*

**Abstract**—*This study aims to analyze the changes and potential of agricultural land within a period of 5 years to develop a beef cattle business in the Kediri City using the concept of urban agriculture which is adapted to local regulations based on land mapping and baseline scenarios. The results of this study were changed in the function of agricultural land in 2014 and 2019 due to the addition of dry land area and reduction of paddy fields based on the results of overlaid mapping of agricultural land in 2014 and 2019. In this land suitability mapping, Kediri City was very suitable for rice fields and dry fields and deserves to be developed except in the area around the mountains in Mojoroto Sub-District. The land carrying capacity of rice straw and corn straw were very low at the assumptions of taking 20%, 35%, and 50% and does not meet the needs of beef cattle feed with the overall carrying capacity index criterion value was < 1. Utilization of agricultural land for beef cattle business development results in perceptions of feed processing equipment, business costs, economy, rat pests, waste products, laws and regulations, urban forests, business permits, other industries, food security, laboratories, agricultural land, employment opportunities, animal feed, development, government, protection, farmers and breeders, beef cattle farm, and farm pollution.*

## I. INTRODUCTION

The high population rate in urban areas causes various kinds of environmental problems, especially the agricultural environment, ranging from land conversion to environmental quality degradation due to pollution and waste. Land is a strategic natural resource for development where almost all physical development sectors require land, such as the agriculture, forestry, housing and other sectors, as well as the largest producer of food needed by humans and the producer of agricultural waste as forage for livestock that needs to be available protection from government regulations and policies. This can be improved by implementing urban farming.

Urban farming is an activity oriented towards the growth, processing, and distribution of food and other products through intensive cultivation of crops and livestock in urban areas and the reuse of natural resources and urban waste to obtain a variety of crops and livestock (Food and Agriculture Organization, 2008). Urban farming can be done by means of an integrated urban farming system that integrates agriculture and livestock in urban areas whose results can be optimized as household food production (Agus, 2020). This also requires land use management so that the integration of agricultural and animal husbandry land can run smoothly, land use management is very important because of its important

role in human development and social welfare (Najmuddin, Deng, and Siqi, 2017).

Agricultural land changes data from 2013-2015, especially on agricultural/animal husbandry lands in East Java, has decreased. In 2013 the area of agricultural land in East Java was 1,102,000 ha, then in 2014 it decreased by 1,101,000 ha and in 2015 it decreased by 1,091,000 ha (Central Statistics Agency, 2016). In 2018 the land area was 7.1 million ha, a decrease compared to 2017 which was still 7.75 million ha. This is due to conversions and changes in the function of agricultural land that occur every year in various regions in Indonesia, for example on agricultural land in Kediri City.

Land conversion is also due to Indonesia's agricultural-based potential, with abundant natural resources, encouraging certain parties to gain profits by converting agricultural land into tourism facilities (Ante, Benu, and Moniaga, 2016). Regulations from the central or local governments cannot overcome or prevent the reduction of agricultural land in each region in Indonesia because the taxes generated by agricultural land are very low compared to residential and industrial taxes.

The Central Statistics Agency of Kediri City (2019) said that agricultural land in Kediri City in 2018 was an area of 1,854 ha of paddy fields, 545 ha of dry land/garden, 2 ha of fields/huma, 1,746 ha of rice harvested area and corn harvest is 972.6 ha, while the agricultural production is rice production of 16,659 tons and corn production of 972.60 tons. In terms of quantity, on average every 1 kg of rice produces about 1 to 1.5 kg of straw (Situmeang, in Purwandaru, 2013), while the Department of Agriculture (2003) adds that the production of rice straw in one hectare of rice fields each time is able to produce about 10 – 12 tons of straw (fresh weight at harvest) or about 5 – 6 tons of straw (dry weight), although it varies depending on the location, type of rice plant variety, cutting method (cutting height) and cutting time, as in the Sintanur variety with cutting height 8 cm of soil can produce 8 – 10 tons of fresh straw or 4-5 tons of dry straw per ha.

Urban farming can be formed in one area if the area has the potential to be used as a new area that can form a certain center such as a center or livestock area. According to Primasworo and Widyastuti (2018), a livestock area is an area specifically used for livestock activities or integrated as a component of farming (food crops, plantations, horticulture, or fisheries) and integrated as a component of certain ecosystems (protected forests, nature reserves) which in its development must pay attention to the optimization of local resources and development policy strategies in each region.

If it is seen from the Regional Regulation on the Regional Spatial Planning (RSP) of Kediri City, which is stated in Article 52 concerning Livestock Areas, it is not in accordance with the fact that there has not been a beef cattle breeding area in the Pesantren Sub-District which has been stated in the Regional Regulation of the Kediri City RSP. The strategic plan for the future is to unite and create a beef cattle business area in the Pesantren Sub-District which is adjusted to the Kediri City RSP Regional Regulation regarding Agricultural and Livestock Areas.

The success or failure of the strategic plan for beef cattle business development also looks at the condition of agricultural land in the Pesantren Sub-District, such as whether or not there is a change in land use, land carrying capacity, water conditions, and others. This is done by land mapping, which is to determine the existence of new strategies related to agricultural land and livestock, both in terms of paddy fields, land carrying capacity, livestock locations, agricultural conditions, as well as livestock socio-economic strategies by making a digital map.

The relationship between urban agriculture, land mapping, and regional regulations for Sustainable Agriculture Food Land (SAFL) and RSP of Kediri City is very useful land mapping to see changes that have occurred in agricultural land in Kediri City since 5 years ago where the remaining agricultural land in Kediri City is protected by the SAFL regulation on the protection of 500 ha of food agricultural land which will be used as urban agriculture by integrating and increasing intensively agricultural and livestock land in urban areas by creating an area or livestock center in Kediri City as stated in the RSP regulation using the urban farming concept in the future.

## II. MATERIAL AND METHODS

The location that was carried out as a research area was Kediri City, to be precise in 3 sub-districts namely Pesantren Sub-District, Kota Sub-District, and Mojoroto Sub-District. This study uses a non-experimental research method whose research form is descriptive research (Saebani and Sutisna, 2018) and also uses a mixed approach method consisting of a qualitative and in-depth approach to the social situation under study (Sugiyono, 2019) and a quantitative approach method that finds and develops the condition of agricultural land in the Kediri City. The research method is divided into 3, namely land research methods, beef cattle feed research methods, and beef cattle breeders research methods.

### 1. Agricultural Land Mapping Research Methods

This research method uses a qualitative approach method which has to look at the changes that occur in agricultural land in the Kediri City widely. In addition, it can also be done using the Google Earth and Google Map applications to view and get the results of the digital data track record of changes in agricultural land in the Kediri City within a period of 5 years. The data collection procedure for the formulation of the problem in this study is divided into two steps, (1) making a land use map and (2) making a map of land units in Kediri City.

Making land use maps of Kediri City will be continued with making maps of land units of Kediri City obtained from overlapping operations called overlays. Rachmah, Rengkung, and Lahamendu (2018) says that the overlay method is an information system in the form of graphics that is formed from combining various individual maps (having specific information/databases) which is carried out with at least 2 different types of maps technically, it is said that custom polygons are formed of 2 types overlaid map.

### 2. Land Carrying Capacity Research Method

This research method uses a qualitative approach method by means of surveys through observation using questionnaires distributed to farmers with open-ended or unstructured questions which are used to obtain more in-depth initial information about various issues or problems experienced by farmers, breeders or farmers related to animal feed in Kediri City (Sugiyono, 2019). The questionnaire data obtained is qualitative data, so the data is converted into quantitative data by measuring the production assumptions of rice straw, corn straw, and elephant grass, the carrying capacity of the land, and the index of the carrying capacity of the land.

### 3. Beef Cattle Breeder's Perception Research Method

This research method is an integral part of research methods on beef cattle feed, namely using a qualitative approach method by means of surveys through observation using questionnaires distributed to farmers with open or unstructured questions which is useful for obtaining more in-depth information about their perceptions of changes in agricultural land and local regulations related to agricultural land protection and food security in Kediri City.

Data collection on the condition of beef cattle farmers in this study can be done by:

- Observation: condition, characteristics and profile of the farmer's business being carried out.
- Interview: this was done to beef cattle farmers in Kediri City.

The number of 1,365 beef cattle breeders in Kediri City was taken by 9 people consisting of 8 beef cattle breeders who really experienced and felt the impact of changes in agricultural land on beef cattle and also knew about the local regulations made by the government. Then, 1 person from the Food Security and Agriculture Department of Kediri City to get answers related to the impact of changes in agricultural land on animal husbandry in the Kediri City and also related to the regional regulations that have been made whether it will have a positive impact on farmers/breeders.

## III. ANALYSIS DATA

### 1. Agricultural Land Mapping Research Analysis

This land mapping data analysis was carried out using an application called GIS (Geographic Information System). The parameters analyzed in this study are Baseline Scenario, Land Carrying Capacity, Strategic Plan for beef cattle business development and predictions of changes in agricultural land in Kediri City in the future supported by the results of questionnaires given to farmers in Kediri City.

### 2. Land Carrying Capacity Research Analysis

The data analysis used in answering the problem formulation in this method:

$$\text{Forage Feed Carrying Capacity (AU)} = \frac{\text{Dry Material Production } \left(\frac{\text{kg}}{\text{yr}}\right)}{\text{Dry Material Needs for Adult Cows } \left(\frac{\text{kg}}{\text{yr}}\right)}$$

Calculation of dry matter requirement for beef cattle can be calculated as follows: Dry matter requirement for adult cattle (kg) = total body weight of adult cattle (kg) x consumption of forage BK (1 – 3%).

### 3. Beef Cattle Breeder's Perception Research Analysis

Analysis of the data used in this study using data analysis model Miles and Huberman. Activities in qualitative data analysis are carried out interactively and take place continuously until complete, so that the data is saturated (Miles and Huberman, 1992) by using a qualitative application called NVivo version 12.2. Activities in this data analysis are data collection, data reduction, data display, and conclusion drawing/verification which can be presented in Figure 1 below:

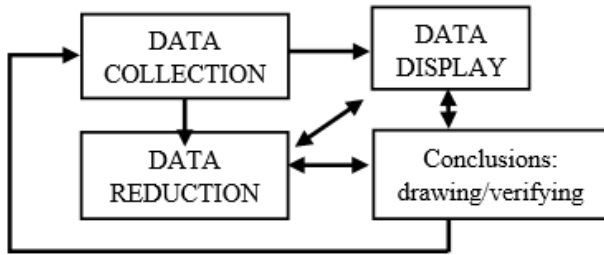


Fig. 1: Components in Data Analysis (Interactive Model) in Qualitative Research

**IV. RESULT AND DISCUSSION**

**1. Kediri City Profile**

Kediri City is one of the medium cities in East Java Province with a population of 285,582 people. The Kediri City is located at 07°45' – 07°55' South Latitude and 111°05' - 112°3' East Longitude with its area divided by the Brantas River into 2 parts, namely the east is a low-lying area are the Kota Sub-District and Pesantren Sub-District and west area is Mojoroto Sub-District which is a highland area with less fertile land. The boundaries of the Kediri City can be seen and shown on Figure 2, Figure 3 and Figure 4 below:



Fig. 2: Kediri city administration map



Fig. 3: Kediri City Map via Google Earth



Fig. 4: Kediri City Map via Google Map and Google Map Satellite

**2. Agricultural Land in Kediri City**

There are 2 types of agricultural land in Kediri City, namely wetland agricultural land is agricultural land that is still productive for planting food crops to produce crop residues of food crops that are used as animal feed such as rice straw and corn straw and dryland agricultural is a non-productive paddy field which is used as vacant land (moor) which is useful for taking field grass as animal feed or even carrying out construction such as housing, shops, and others.

The total area of harvested land and harvested production from rice field land use can be presented in table 1 below:

Table. 1: Area for Harvesting and Production of Rice Fields in Kediri City

Land Use	Harvested Area (ha)			Production (kw)		
	2014	2015	2019	2014	2015	2019
Paddy	1,707	1,977	1,488	97,897	127,292	76,959.36
Corn	883	1,066	911	56,909	73,458	63,737.78
Other Agricultural Crops	65	85	21.3	5,675	6,985	132.94
<b>Total</b>	<b>2,655</b>	<b>3,128</b>	<b>2,612</b>	<b>160,481</b>	<b>207,735</b>	<b>140,830.08</b>

Based on the results of table 5 above, the harvested area of paddy, corn and other agricultural crops (cassava, sweet potatoes, peanuts, and soybeans) from 2014 to 2015 each increased by 270 ha in paddy fields, 183 ha on corn fields, and 20 ha on rice fields for other agricultural crops. This is due to the use of dryland agricultural which is again used as wetland agricultural (rice fields). Meanwhile, in 2019 there was a decrease in the harvested area of paddy, corn,

and other agricultural crops due to the large number of rice fields being used for development such as housing construction, city parks, shops, non-productive rice fields, and others.

Productive agricultural land for farmers/breeders are not only used as foodstuffs such as rice and corn, but also used to plant elephant grass as an additional forage of animal feed if the availability of elephant grass in the moor, forest, or vacant land is insufficient. Although the wetland agricultural or rice fields is often used by farmers to take advantage of the remaining production of rice and corn as a beef cattle feed, farmers also use dryland agricultural to take grass such as field grass and elephant grass as the main beef cattle feed.

This increase in moor land occurs due to changes in land use from productive agricultural/rice fields into a non-productive agricultural land, which will later be used as housing, shops, other buildings, or as a vacant land to grow the field grass intentionally use a beef cattle feed.

3. Agricultural Land Mapping in the Kediri City

3.1. Land Use Mapping in Kediri City

Land use mapping serves to identify, understand and observe land use changes in the Kediri City in 2014 and 2019. Land use is useful in the development and use of land or soil in Kediri City to become a new sector either the agricultural sector, the livestock sector as well as the industrial sector, government, and services. Land use mapping in 2014 and 2019 can be presented in Figure 5 and Figure 6 below:

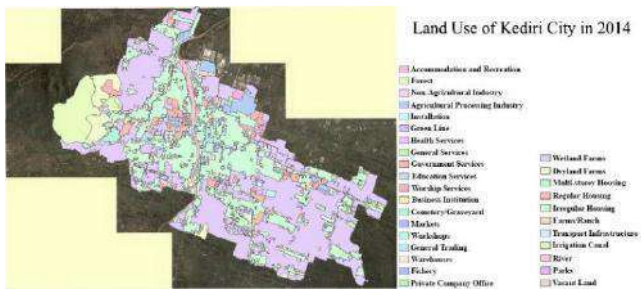


Fig. 5: Land Use of Kediri City in 2014

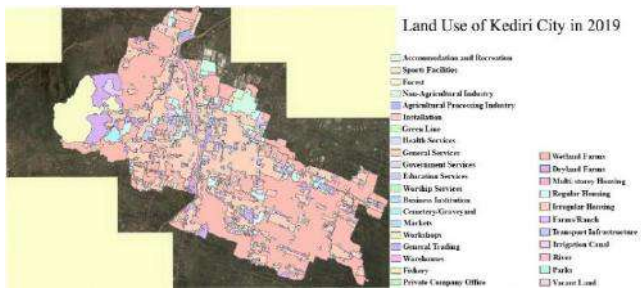


Fig. 6: Land Use of Kediri City in 2019

Based on Figures 5 and 6 above, there was a change in land use in the Kediri City in 2019 with the addition of

onew sector, namely the existence of sports facilities where this was still not available in 2014. The land use changes that are not used or maintained and it can also from rice fields, dryland agriculture or vacant land. This land use change in Kediri City occurred in 5 years from 2014 to 2019. An explanation of the results of the overlay and the areas that have changed the land use Kediri City can be presented in Figure 7:

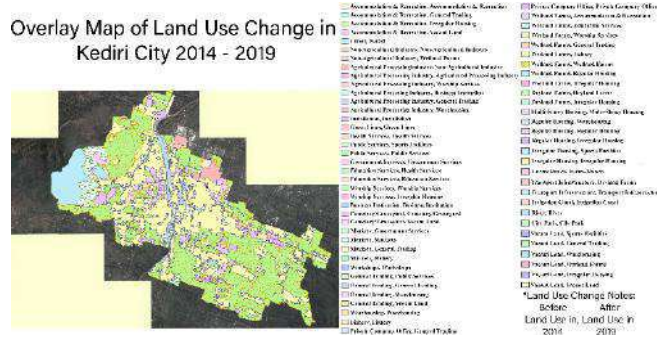


Fig. 7: Overlay Map of Land Use Change in Kediri City 2014 – 2019

The results of the overlay mapping of land use changes in Figure 7 above, the uses of land use in 2014 in Kediri City there were many land use changes in 2019 such as wetland agriculture (rice fields) in 2014 there was no change in land use, within 5 years to be precise in 2019 there was a change in land use in rice fields which became educational services, worship services, etc. and dryland agriculture (moor) there was also no change in land use in 2014, but in 2019 changed to irregular housing. This land use change is usually due to the Kediri City government fulfilling the people of Kediri City needs or there are even investors who invest in Kediri City by build new sectors or expanding existing sectors.

Land use changes in Kediri City are more common in wetland agriculture (rice fields), dryland agriculture (moor), and also on vacant land, the rest comes from other sectors/facilities such as housing, government, private companies, industry, and others. Broad reduction occurred in the type of use of thicket forest, mixed gardens, meadows/sabana, irrigated rice fields, rainfed rice fields, barren land, and moorings / fields (Rumetna, Sedyono, and Hartono, 2017).

Land use changes on wetland agriculture more often in Kediri City because farmers/breeders are unable to process the land they have and the income produced from land is not able to meet daily necessities, so that they change the land use into dryland agriculture or non-productive agricultural land for sale. Yagi and Garrod (2018) said that farmers with good fixed income can maintain agricultural land. Given the lower fixed income,

farmers with large land areas are assumed to tend to sell their property such as farmers/breeders in Kediri City who sell rice fields and moorings and even their livestock are also sold and switch to a more established profession.

Farmers and breeders in Kediri City get a low wage or income from the minimum wage established by the city government in Kediri City because the agricultural products obtained change. Gyapong (2020) said that the minimum wage has attracted policy attention, but now as an effective measure to overcome poverty and as a means of social protection for vulnerable groups, assuming to provide guarantees for workers with low-skills low wages to get "worthy" wages and sustain at least subsistence living standards.

### 3.2. Wetland Agricultural Land Mapping

The retrieval of maps of wetland agriculture from 2014 and 2019 serves to see how many changes have occurred to paddy fields in Kediri City which have an impact on crop production and the remaining yields of rice and corn which are used as beef cattle feed in Kediri City. The data on the area of paddy fields and the resulting production in table 1 which is processed using the Geographic Information System application can be presented in Figure 8:



Fig. 8: A. Land Mapping of Wetland Agricultural in 2014 (left); B. Land Mapping of Wetland Agricultural in 2019 (right) Kediri City.

Wetland agriculture (rice fields) in 2014 in Kediri City had a total land area of 2,655 ha with crop yields of 160,481 kw or 16,048.1 tons, and rice fields in 2019 had a total land area of 2,612 ha with crop yields of 140,830.08 kw or 14,083,008 tons. The results of the overlay mapping of rice fields between 2014 and 2019 can be presented in Figure 9:



Fig. 9: Land Mapping Overlay of Rice Fields Between 2014 and 2019

Based on the overlay results from the mapping of rice fields in Figure 9 above, the pink color in the mapping of rice fields which in 2014 still exist in the rice fields, but on the map of agricultural land in 2019, rice fields are marked with pink color on the 2014 land map changed. Changes or not the wetland agriculture is due to changes in the function of rice fields so that changes in land use also change which at first the land use was used as agricultural land, then turned into housing, shops, warehousing, and others.

The changes of land conversion are due to the owners of wetland agriculture, both farmers and wetland agriculture holders themselves, by selling their land to improve the family's economy or switching to more established jobs such as construction workers, and others. According to Dewi and Rudiarto (2013), usually the owners of agricultural land are in one clump or one location in a certain area which then almost simultaneously sells their agricultural land.

Another cause is population growth rate that is getting faster from year to year so that the need for facilities such as housing, shops, and other facilities increases drastically. This population growth rate is not natural, but the number of residents who are not native to Kediri City moved and settled in Kediri City, many of whom came from outside Kediri City such as Kediri Regency, big cities like Jakarta, Surabaya, and others. According to Janah, Eddy, and Dalmyatun (2017), the main factor that contributes to the decline in agricultural land is the rate of population growth which causes an increase in the need for settlements and other facilities, and the rate of population growth is not only natural growth, but also due to population movement as a result of the location of Sayung Sub-District which is close to the industrial center in Semarang City.

The reduction in wetland agriculture in Kediri City does not affect wetland agriculture that protected by the Kediri City Government, especially the Food Security and

Agriculture Department into Regional Regulations in Chapter IV of the determination of SAFL Protection Article 8 and Article 9 and Chapter IX Control of Land Transfer Article 30 and article 31.Boz (2016) says that sustainability in agricultural production; in economic terms it means generating sufficient income for the farmers; and finally, in social terms it means enjoying rural life which is open to social change and development.Sutrisno and Setiawan (2018) added, the Law on Protection of Sustainable Urban Agricultural Land is one of the political and legal breakthroughs from the government to protect agricultural land, the government has shown its serious concern about the conversion of agricultural land and the achievement of food security.

### 3.3. Dryland Agriculture Land Mapping

Not only wetland agriculture that can be used to get animal feed, but non-productive agricultural land such as dryland/vacant land is also used to get animal feed, for example grass (field grass and elephant grass) which is intentionally planted by farmers/breeders.The area of dryland in each sub-district in 2014 and 2019 is presented in table 2 below:

Table. 2: Total Area of Dryland Agriculture in Kediri City

No	Sub-district	Area of Dryland Agriculture/Moor (ha)	
		2014	2019
1	Mojooroto	190.22	216
2	Kota	61.93	55
3	Pesantren	282.15	274
<b>Total</b>		534.30	545

Based on table 2 above, the increase in the area of dry land is due to improper use of land and productive rice fields become non-productive rice fields for planting grass (elephant grass and field grass).The area that has the most dryland agricultural is Mojooroto Sub-District which is a dry area and the western part is bordered by 2 mountains, namely Mount Klotok and Mount Maskumambang and Pesantren Sub-District is a wet area that has springs and there are also a lot of rice fields (Central Statistics Agency of Kediri City, 2019). Land mapping of dryland agricultural can be presented in Figure 10:

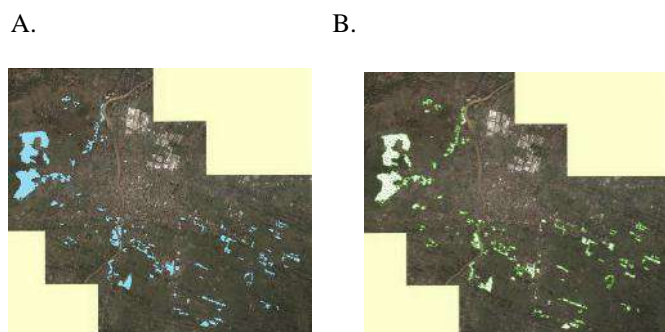


Fig. 10: A. Land Mapping of Dryland Agricultural in 2014 (left); B. Land Mapping of Dryland Agricultural in 2019 (right) Kediri City

Based on Figure 10 above, the medium blue color is the location of the distribution of dryland agricultural in Kediri City in 2014. The white color with green lines and dots is the location of the distribution of dryland agricultural in Kediri City in 2019. There is an increase in the area of dry land in 2019 which located in the Mojooroto Sub-District.The addition of dryland area can be seen in Figure 11 as a result of the overlay between the land mapping of dryland agricultural in 2014 and 2019:



Fig. 11: Land Mapping Overlay of Dryland Agricultural 2014 and 2019

The climate and topography in Mojooroto Sub-District are very different from other sub-districts in Kediri City which the area is dry but the temperature is cool mixed with heat due to the strong winds intensity and the humidity also changes frequently, so this sub-district is characterized as an area that is less fertile and not suitable as an agricultural area.Dry land environments are often characterized by relatively cold and dry seasons which are categorized as semi-arid with a ratio value of 0.20 to 0.50 P/PET (precipitation to potential evapotranspiration), followed by relatively hot and dry seasons which are categorized as arid with ratio values. 0.05 to 0.20 P/PET, lastly the dry season and dry rain which are categorized as dry sub humid with a ratio value of 0.50 to 0.65 P/PET (Food and Agriculture Organization, 2008).

Dryland agriculture also includes land protected by the government of Kediri City which has been listed in the Regional Regulation of the Food Security and Agriculture Department of Kediri City in chapter IV regarding the stipulation of SAFL Protection article 8 paragraph 2 and paragraph 3 and the Ministry of Agriculture Regulation article 29 paragraph 1 to verse 7. Sardiana, et al (2017) said that the newest vegetation on dry land in Tegalalang is Orange, Papaya, Peanut, Coffee, Salak, Chili, Cassava, Ginger, Chocolate, Coconut, Big Grass, Banana, Sweet Potato and Mangosteen. The dryland agriculture in Kediri City is used by farmers/breeders to plant elephant grass as feed for beef cattle, soybeans, cassava, sweet potatoes, and bananas which are additional food ingredients other than rice and corn.

3.4. Land Suitability in Kediri City

3.4.1. Slope Level and Slope Type

Land suitability in Kediri City consists of slope level, slope type, soil type, and climate which are included in environmental/ecological factors and land suitability that has been mapped by the Regional Development Planning Agency (RDPA) of Kediri City. The area of the slope level in Kediri City can be presented in table 3:

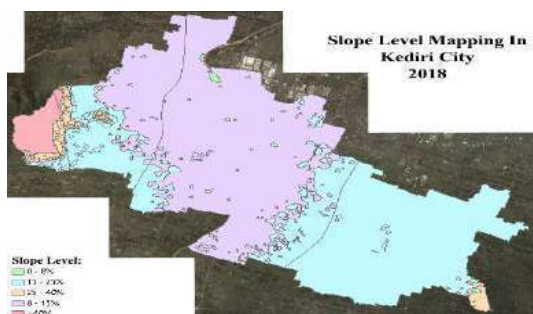
Table. 3: Total Area of Slope Level in Kediri City

No	Sub-district	Total Area (m <sup>2</sup> )	Slope Level	Slope Area (m <sup>2</sup> )
1	Mojoroto	24,60	0 – 8%	1.64
			8 – 15%	8.2
			15 – 25%	6.56
			25 – 40 %	3.28
			> 40%	4.92

2	Kota	14,90	0 – 8%	1.354
			8 – 15%	10.836
			15 – 25%	2.71
3	Pesantren	23,90	8 – 15%	4.345
			15 – 25%	17.382
			25 – 40%	2.173

The land slope level is 8 – 15% consisting of the total area of Mojoroto Sub-District covering an area of 8.2 m<sup>2</sup>,  $\frac{8}{11}$  from the Kota Sub-District area of 10.836 m<sup>2</sup> and  $\frac{2}{11}$  from the total area of the Pesantren Sub-District covering an area of 4,345 m<sup>2</sup>. At a slope level of 15 – 25%, it is divided into Mojoroto Sub-District with an area of 6.56 m<sup>2</sup> or  $\frac{4}{15}$  its area, Pesantren Sub-District with an area of 17.382 m<sup>2</sup> or  $\frac{8}{11}$  its area, and Kota Sub-District with an area of 2.71 m<sup>2</sup> or  $\frac{2}{11}$  from the area of Kota Sub-District. The slope level of 0 – 8% is found in the Mojoroto Sub-District area which is on the banks of the Brantas River with an area of 1.64 m<sup>2</sup> or  $\frac{1}{15}$  of the total area of Mojoroto Sub-District and its  $\frac{1}{11}$  or 1,354 m<sup>2</sup> is located on the banks of the Brantas River, Kota District. The slope level of 25-40% is located on the slopes of Mount Klotok and Mount Maskumambang, Mojoroto District, covering an area of 3.28 m<sup>2</sup> or  $\frac{2}{15}$  the area of Mojoroto District and  $\frac{1}{11}$  or 2.173 m<sup>2</sup> of area in Pesantren District. This 40% slope level is in the area of Mount Klotok, Mojoroto District, which has an area of 4.92 m<sup>2</sup> or  $\frac{3}{15}$  of the total area of Mojoroto Sub-District. To clarify the level of slope above can be seen in Figure 12 which is presented as follows:

A. Slope Level Mapping



B. Slope Type Mapping

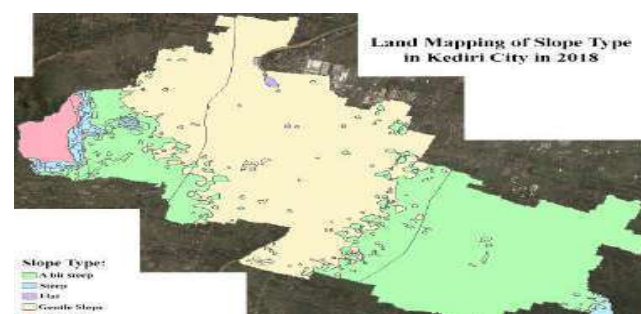


Fig. 12: A) Slope Level Mapping (left); B) Slope Type Mapping (right) in Kediri City

The results of the assessment of slope level and slope type that has been mapped in Figure 12, the level of slope 0 – 8% is marked in green and has a flat type of slope, the

level of slope 8 – 15% is purple has a gentle slope type, the slope level is 15 – 25% is marked in light blue with a slightly steep slope type, 25 – 40% has an orange color and



the slope type is steep, and a slope level > 40% is red and the slope type is very steep. According to Terfa and Suryabagavan (2015), a relatively flat area and must be more than 80% of the rangeland area (land use, soil, slope, and rainfall) is very suitable for all categories of livestock simultaneously. The Mojoroto sub-district area is not suitable to be used as livestock land due to the contours of the land and the high slope of the land. Parmawati, et al (2018) say that the slopes of the land that can be used for livestock are in the second strata category, namely the slope is less than or equal to 15%, and some land has a slope of less than or equal to 35% can be utilized by modifying the contour of the soil in stages. The farmers/breeders in Mojoroto sub-district have modified the contours of the land to make it balanced and even by adding new soil so that the contours of the land become flat.

The slope level and the slope type will determine the danger or not of soil erosion that occurs, land management such as agricultural land, and the influence of high and low temperatures and solar radiation in a place, especially in Kediri City. Terfa and Suryabagavan (2015) added, slope is a very important factor to determine the suitability of rangeland for animal production, animal can easily graze on flat and gentle slopes and most of the feed consumed is used for fattening without much energy loss. The lands in Kediri City have different land slopes and land slopes types so that the arrangements and management are also different, which must follow the rules of the Ministry of Agrarian Affairs and Spatial Planning and the Ministry of Agriculture of the Republic of Indonesia.

3.4.2. Kediri City Climate

The climate in this study is meant by rainfall which will determine whether suitable or not the production of livestock, the level of fertility in plants, soil fertility and moisture, and others. Based on rainfall data from the Central Statistics Agency of Kediri City (2020), rainfall in the Kediri City area has rainfall ranging from 1,671 mm per year in 2019 with an average rainfall for the 2016 – 2019 period of 2,128.25 mm where the highest rainfall is in 2016 of 3,456 mm per year and the lowest in 2018 was 1,409 mm per year.

Regional biophysics in Kediri City has more flat and gentle slopes in each area with an average annual rainfall of 847.33 mm and an average total rainfall in the 2016 – 2019 period of 2,128.25 mm. Biophysically areas with flat to gentle slopes, grasslands and areas with an average annual rainfall of > 800 mm are very suitable for the production of beef cattle and sheep (Terfa and Suryabagavan, 2015). However, this is not in accordance with Suhaema, Widiatmaka, and Tjahjono (2014) where high rainfall intensity (>4,000 mm per year) and slopes

>15% affect the suitability of forage growing in pastures, because the City of Kediri only has rainfall ranging from 1,400 – 3,460 mm per year and also Kediri City is a lowland area even though the City of Kediri also has a slope of > 15% in each area.

In 2019 the rainfall in the early season in Kediri City began in November where food crops (rice and corn) and also animal feed (elephant grass and field grass) got good growth. Brown, et al (2019) say rainfall in the early season, promotes the growth of high-quality green pastures which has a significant positive impact on livestock performance at a time when pasture is usually of very low quality.

3.4.3. Soil Type

Soil type is also an important factor for agricultural lands in all regions in Indonesia, especially in Kediri City, it because it can affect condition of the land both wet and dry land agriculture, the absorption of water into the soil is good or not, and mineral content contained in the soil that is useful for plants in wet and dry land. The total area based on soil type in Kediri City can be presented in table 4:

Table. 4: Total Area Based on Soil Type

Sub-district	Total Area (m <sup>2</sup> )	Soil Type	Soil Type Area (m <sup>2</sup> )
Mojoroto	24,60	1. Association of gray alluvial and gray-brown alluvial	12.30
		2. Alluvial	8.20
		3. Mediterranean reddish brown and lithosol	4.10
Kota	14,90	1. Association of gray alluvial and gray-brown alluvial	14.90
Pesantren	23,90	1. Association of gray alluvial and gray-brown alluvial	7.97
		2. Gray-brown regosol	15.93

Based on table 4, the Kediri City has 4 types of soil, namely alluvial soil, association gray alluvial and gray brown alluvial, reddish brown mediterranean and lithosol, and gray brown regosol. All areas in Kota Sub-district in Kediri City have gray alluvial and gray brown alluvial association soil types, then Mojoroto Sub-district has 3 types of soil, namely  $\frac{1}{2}$  of the total land area adjacent to the

Brantas River has an association of gray alluvial and gray brown alluvial soil type,  $\frac{1}{3}$  of the land area of the total area has alluvial soil type, and  $\frac{1}{6}$  of the land area located in mountain areas has reddish brown mediterranean soil types and lithosols. In the Pesantren Sub-District area, there are 2 types of soil, namely  $\frac{1}{3}$  of the total land area of the Pesantren Sub-district which has gray alluvial and gray brown alluvial association soil types and  $\frac{2}{3}$  of the land area has gray brown regosol soil type. Based on the statement of the type of soil and its total area can be seen in the mapping image of soil types in the Kediri City which is presented in Figure 13:

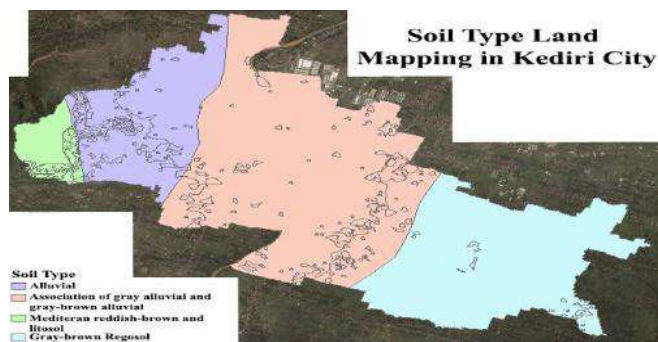


Fig. 13: Soil Type Land Mapping in Kediri City

#### 3.4.3.1. Alluvial Soil

Alluvial soils, both alluvial and alluvial associations (gray and gray brown) in Kediri City based on an explanation from the Directorate General of Human Settlements (2014) which are under the auspices of the Ministry of Public Works and Public Housing, the soils that have parent material of clay deposits originating from new deposits, layers, organic matter in irregular amounts in depth. The soil is quite deep and has a coarse to sandy texture on the upper boundary, a fine clay texture on the lower limit, a weak fine lump structure to subangular, medium calcareous, with very low organic carbon, slightly alkaline, and non-salt (Djili and Hamdi-Aïssa, 2017).

According to Bowles, et al (2018), the mineral content of alluvial soils consists of a mixture of Pt-Fe (Platinum-Iron), euhedral crystals of a mixture of Os-Ir (Iridosmine/Osmium+Iridium) and laurite-erlichmanite (RuS<sub>2</sub>-OsS<sub>2</sub>). can be arranged in the Pt-Fe alloy or occur independently. Small proportions of tulameenite (Pt<sub>2</sub>CuFe) are also present, platinum-group element sulfides (PGE) and tellurium and Cusulfides have been reported as inclusions in Pt-Fe nuggets. However, for the type of soil in Kediri City, more than 85-90% mostly converted from agricultural land (rice fields or moor) towards development such as settlements, malls, shops, and others, leaving agricultural lands that utilize this alluvial soil type.

#### 3.4.3.2. Regosol Soil

Regosol soil type in Kediri City according to the Directorate General of Human Settlements (2014) is soil with a coarse-textured acid volcanic ash/sand as the parent material with a sand content of more than 60%. This land is suitable for the use of primary and secondary forests, shrubs, secondary crops and grasses. Putinella (2014) added that the soil is dominated by the sand fraction (82.62%) followed by the dust fraction (13.16%) and the clay fraction (4.22%) so that it is included in the loamy sand texture class. This is very much in accordance with the soil conditions in the Pesantren Sub-District which in one of the rice fields where the characteristics of the soil are dusty, it is dominated by sand mixed with clay. In addition, the soil in the Pesantren Sub-District also comes from volcanic ash/sand from the eruption of Mount Kelud, making the soil in this sub-district coarse and sandy in texture.

VandenBygaart (2011) adds, regosolic soils are also widely distributed along tributaries and rivers where river displacement and alternating flooding provide new parent material for colonization through vegetation and pusher exposure from the earth's surface. Pesantren Sub-District areas have Green Open Spaces (GOS), namely primary and secondary forests as associations of vegetation with springs and soil types and are suitable for ruminant livestock both beef cattle and dairy cattle, this is also appropriate and stated in the Kediri City regulation of Regional Spatial Planning City (RSP) article 52 concerning livestock areas.

#### 3.4.3.3. Mediterranean and Lithosol Soil

Lithosol and Mediterranean soils located in Mojoroto Sub-District, precisely on the slopes and peaks of Mount Klotok and Mount Maskumambang, have a slightly dense soil texture at the top and many have rocks underneath. According to the Directorate General of Human Settlements (2014), lithosol soil is mineral soil with a thickness of 20 cm or less, underneath which there is an integrated hard rock. Priyono, et al (2019) said that the soil is very poor in nutrients and is a soil residue that has been eroded or degraded for hundreds of thousands of years, the texture is sandy, the primary particles are dominated by resistant minerals (silicious, rich in silicate/quartz), poor in macro and mineral elements. micro, except potassium. It is same as soil conditions in Mount Klotok and Mount Maskumambang areas which is the soil that has been degraded since the time of the Kadhiri kingdom so that this land is not very suitable for agricultural land, both rice fields and moor, but suitable for forestry land.

As for Mediterranean soils, according to Priyono, et al (2019), in the rainy season, the soil expands laterally

causing the morphology of the soil surface in the form of small mounds (25 - 75 cm wide, 10-15 cm high) called 'gilgey' and in the dry season, the soil stretches and produces cracks 2-10 cm wide enough to >60 cm deep. Siles, et al (2014) said that the analyzed mediterranean soils had remarkable microbial diversity, reductions in functional diversity as well as changes in functional community structure depending on the type of treatment applied considering the different types of carbon sources provided. Based on the Mediterranean soil conditions from the statements of Priyono, et al (2019) and Siles, et al (2014), this is very suitable in the area of Mount Klotok and Mount Maskumambang where this type of soil during the rainy season and dry season often changes, so that the condition of this land undergoes changes in land function and cannot be used as agricultural land like in other areas.

### 3.5. Water Status in Kediri City

The status or condition of water in the Kediri City was not taken, due to the large number of employees working at home due to the corona virus (COVID-19) pandemic and also difficulty in obtaining permits and contact restrictions (social & physical distancing) to people around so as not to spread or contracting the corona virus. Most of the people of Kediri City, especially farmers and ranchers, use well water as the main water source that is used and utilized by them for daily life and for drinking water for their livestock. The use of water sources used by the people of Kediri City can be presented in Figure 14 below:

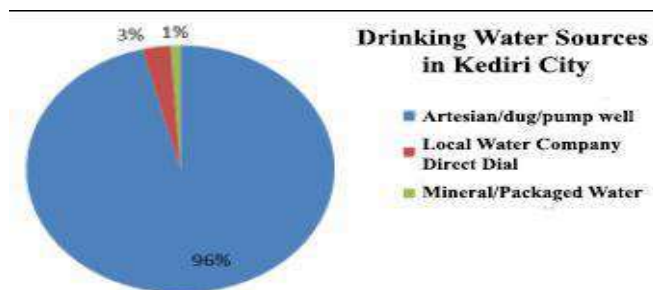


Fig. 14: Drinking Water Sources in Kediri City

Based on Figure 14, the results of the 2014 Kediri Wastewater Master Plan Preparation survey found that 96% of the people of Kediri City use and utilize artesian/dug/pump well as their main water source, 3% use direct connections from Local Water Company and 1% use bottled/mineral water. This proves that the quality and status of water in Kediri City is still feasible to be used as a source of clean water and also does not require expensive costs in its use where the quality of this spring is still relatively clean, clear, and safe for consumption or use for daily needs. According to Sasongko, Widyastuti, and Priyono (2014), industrial, domestic and other activities

have a negative impact on water resources, including a decrease in water quality.

Organic chemicals contained in the dug well water in Kediri City have negative or safe results from organic substances in the dug well water, even though the soil in Kediri City in the explanation of the Soil Types above contains a lot of organic substances. According to Ningrum (2018), this organic substance is easily decomposed by bacteria using dissolved oxygen. Organic substances present in water come from nature or as a result of human activities.

### 3.6. Omnibus Law Against Agriculture and Livestock in Kediri City

The Omnibus Law related to agriculture and animal husbandry starting from land and livestock cultivation systems, land protection, animal feed, etc. are regulated by the Central Government as in Article 8 paragraph 3 where the authority of the Central Government in spatial planning of national strategic areas includes:

- Determination of national strategic areas
- National strategic area spatial planning
- Utilization of national strategic area space
- Controlling national strategic area space use

According to Sukarman (2021), in the Job Creation Law, the government and companies have the authority to unilaterally determine the location of infrastructure development without the consent of the community. This is because Regional Governments such as governors and mayors/regents no longer stipulate spatial planning, and others as stated in Article 10 of the Omnibus Law which reads:

- Regulating, fostering, and supervising the implementation of spatial planning in the provinces and districts/municipalities.
- Implementation of provincial spatial planning.
- Cooperation in spatial planning between provinces and facilities for cooperation in spatial planning between districts/cities.

In fact, the space for agricultural areas in Kediri City has not been formed and has even experienced a setback due to the conversion of land functions in Kediri City. The non-realization of a sustainable agricultural land policy will have three implications, namely the decline in productive land, interrupted farmer regeneration, and the occurrence of land conversion (Saifulloh, 2021).

Animal husbandry is also regulated by the Central Government both in terms of grazing areas, animal feed, business permits, and others. One example is found in Article 22 paragraph 2 and paragraph 4. Article 22 paragraph 2 states that the feed made must comply with

the standards or terms and conditions of the manufacturing method that has been stipulated by Government Regulation, in Article 22 paragraph 4 which states that animal feed shall not or be prohibited from containing feed ingredients in the form of blood, meat, and bones as well as feed mixed with hormones or antibiotics. According to Saifulloh (2021), the conception of state control over land and other natural resources as well as arrangements regarding the guarantee of individual property rights and communal rights of indigenous peoples in the constitution.

Table. 5: Rice Production on 2018/2019 in Kediri City

Sub-District	Area of rice field (Ha)	Rice planting area (Ha)	Productivity (Ton/ Ha)	Production (ton)	
				Early Harvest	Rice Straw
Mojoroto	509	926	6.9	6,154.91	5,108.57
Kota	257	416	7.2	2,885.28	2,394.78
Pesantren	185	177	6.7	1,142.38	948.17

Based on table 5 above, the production of rice in Kediri City at the beginning of the harvest is rice that has just been harvested and is weighed at 10,182.57 tons/year. While rice straw is the result of dry rice plant residues and can no longer be used by humans which is used as animal feed of 8,452.52 tons / year.

Not all rice straw is taken by farmers/breeders in Kediri City as beef cattle feed, because they prefer to burn straw as mulch on the ground. The assumption of taking rice straw by farmers/breeders in Kediri City can be presented in table 6 below:

Table.6: Assumption of Harvesting Rice Straw as Beef Cattle Feed

Sub-District	Rice Straw Production (ton)	Assumption of Rice Straw Harvesting		
		20%	35%	50%
Mojoroto	5,108.57	1,021.71	1,787.99	2,554.29
Kota	2,394.78	478.96	838.17	1,197.39
Pesantren	948.17	189.63	331.86	474.09
<b>Total</b>	<b>8,451.52</b>	<b>1,690.30</b>	<b>2,958.02</b>	<b>4,225.77</b>

Based on table 6 above, rice straw harvesting carried out by farmers/breeders in Kediri City is assumed to be 20%, 35%, and 50% respectively of the total production of rice straw produced in each sub-district in Kediri City. This is done because farmers/breeders often pile up and burn rice straw or use rice straw as mulch on their land. Farmers pile up and burn straw directly on paddy fields, although some farmers use straw as mulch (natural soil

#### 4. Forage Feed for Beef Cattle in Kediri City

##### 4.1. Rice Straw

This rice plant is a food crop that is often planted by farmers, especially farmers in Kediri City who produce rice as food and the rice straw is used as beef cattle feed in Kediri City. Rice production when viewed from the initial rice harvest and straw is presented in table 5 below:

fertilizer), compost and animal feed (Tommy, Mukhlis, and Hidayat, 2014).

The production of early harvested rice into rice straw has decreased in each of these districts by 83%, because the paddy has no rice grains and undergoes a drying process so that the water content in the rice decreases, leaving only dry paddy or rice straw. According to Patiung (2015), this shrinkage rate is due to the accumulation of rice that does not use an adequate base and the rice is only placed on the harvested land.

These farmers/breeders in Kediri City still have limited insight and knowledge about rice straw processing, especially the processing of fermented feeds such as silage. The Agency for Extension and Development of Agricultural Human Resources (2019) states that silage is feed made from forage, agricultural by-products or grains with a certain moisture content that has been preserved by storing in an airtight container for approximately three weeks.

The use of rice straw by farmers/breeders for beef cattle is only when the health condition of the farmers/breeders, the weather is unfavorable to take grass or the amount of elephant grass is not sufficient so that the farmers/breeders mix elephant grass with rice straw as feed. So, beef cattle belonging to farmers/breeders only consume dry matter contained in rice straw rather than other nutritional content such as crude protein, crude fat, and crude fiber, even though beef cattle also need these nutrients.

#### 4.2. Corn Straw

Apart from rice, corn is also a food crop that is often planted by farmers in Kediri City as a food substitute for rice and also as an animal feed ingredient, either made as

concentrate or used directly as corn straw. Corn production is the same as rice production which has 2 types of production which can be seen in table 7 below:

Table.7: Corn Production on 2018/2019 in Kediri City

Sub-District	Total Area (Ha)	Corn Planting area (Ha)	Productivity (Ton/Ha)	Production (ton)	
				Early Harvest	Corn Straw
Mojoroto	509	515	8.0	3,968.80	1,547.83
Kota	257	112	8.2	884.69	345.03
Pesantren	185	371	7.9	2,823.34	1,101.10

Based on table 7 above, corn production in Kediri City from corn fields was obtained at 7,676.83 tons per year for early harvest corn and 2,993.96 tons per year for corn straw. The production of early harvested corn into corn straw in each sub-district has decreased by 39% where this corn plant has corn cobs, corn husks, leaves from corn plants and corn stalks, causing the shrinkage of this corn plant to be much higher. The assumption of corn straw harvesting can be seen in table 8 below:

Table.8: Assumption of Harvesting Corn Straw as Beef Cattle Feed

Sub-District	Corn Straw Production (ton)	Assumption of Corn Straw Harvesting		
		20%	35%	50%
Mojoroto	1,547.83	309.57	541.74	773.92
Kota	345.03	69.01	120.76	172.52
Pesantren	1,101.10	220.22	385.39	550.55
<b>Total</b>	<b>2,993.96</b>	<b>598.79</b>	<b>1,047.89</b>	<b>1,496.99</b>

Corn straw harvesting assumption in table 8 above is the same as rice straw harvesting assumption which is respectively 20%, 35%, and 50% of the total production of corn straw without corn cobs in each sub-district in Kediri City. This assumption was made because farmers/breeders also piled and burned corn straw, and even used it as a natural fertilizer (mulch) in their paddy fields rather than as feed for their beef cattle. According to Adrinal, Saidi, and Gusmini (2012) regarding mulch, one of the advantages of giving mulch is that the addition of mulch that has undergone decomposition will contribute nutrients to the soil, especially potassium.

The use of corn strawsame as the use of rice straw, is rarely done by farmers/breeders in Kediri City and uses it as a reserve for beef cattle feed when grass production begins to decrease. Just like rice straw, corn straw has a

different nutritional content from browned dried corn which will have an impact on the nutritional content of the beef cattle.

The nutritional content of corn straw is 50.0% dry matter, 5.56% crude protein, 33.58% crude fiber, 1.25% crude fat, and 8.42% ash (Islamiyati, 2013). Meanwhile, according to Yuniarsih and Nappu (2013) also analyzed the nutritional content of leaves from corn straw, namely crude protein 5.80%, crude fiber 27.38%, crude fat 2.90% and ash 8.21%.

#### 4.3. Elephant Grass

Elephant grass is often used by breeders/farmers in Kediri City, because this grass is easy to obtain and is also the main animal feed for their beef cattle. The estimation of elephant grass production on land in each sub-district in Kediri City on the area of the land with the amount of elephant grass taking which is often taken by breeders/farmers based on the results of interviews obtained can be seen in table 9 below:

Table.9: Elephant Grass Production Estimate

Sub-District	Elephant Grass					
	Land use	Total area	Planting area	Land ownership	Daily intake (kg)	Estimated Production (tons/yr)
<b>Mojo roto</b>	Forest	251.70 ha	62.925 ha	Government	40	906.12
<b>Kota</b>	Wetland	5,000 m <sup>2</sup>	5,000 m <sup>2</sup>	Farmer	100	126
<b>Pesantren</b>	Wetland	5,000 m <sup>2</sup>	5,000 m <sup>2</sup>	Farmer	350	36

Based on the results of table 9, the land for elephant grass has a  $\frac{1}{4}$  ha area of the total urban forest area in

Mojooroto Sub-District covering a 62,925ha areas and the estimated production is 906.12 tons/year. Meanwhile, in the Kota and Pesantren Sub-Districts, the elephant grass land is paddy field and is owned by the breeder himself with a total land area and planting area of 5,000 m<sup>2</sup> and the estimated production is 126 tons/year and 36 tons/year, respectively, with daily take of 100 kg/day and 350 kg/day. The average fresh forage production at a 20-day defoliation interval of 14.15 tons/ha has a higher tendency than the 40-day defoliation of 13.07 tons/ha. It is because there are different elephant grass varieties that are planted and used by farmers in Kediri City as an animal feed (Seseray, Saragih, and Katiop, 2012).

The estimated production of elephant grass in the city of Kediri is higher than the production of elephant grass set by Reksodiprodjo (1994) where elephant grass can reach 100-200 tons/ha/year and elephant grass odot can reach 30-50 tons/ha/year, but lower than elephant grass

production which studied by Lugiyo and Sumarto (2000) where the fresh production of cv Hawaiian elephant grass is 525 tons/ha/year and African cv elephant grass is 376 tons/ha/year. If the estimated production of elephant grass in Kota and Pesantren sub-districts produces 126 tons/year and 36 tons/year per 5,000 m<sup>2</sup> ( $\frac{1}{2}$  ha), then per 1 ha it can produce 252 tons/year and 72 tons respectively. tons/year.

#### 4.4. Land Carrying Capacity in Kediri City

The number of beef cattle greatly determines the amount of animal feed taken by breeders and farmers which is measured in terms of the carrying capacity of the land in Kediri City. Land carrying capacity itself is useful for measuring the ability of the feed capacity of wetland agriculture in Kediri City to be used as feed for beef cattle. Land carrying capacity in Kediri City based on animal unit (AU) can be seen in table 10 below:

Table.10: Land Carrying Capacity in Kediri City

Sub-District	Land Carrying Capacity (AU)							
	Rice (DM 1,5%)			Total	Corn (DM 1,5%)			Total
	20%	35%	50%		20%	35%	50%	
Mojooroto	582.17	1,018.80	1,455.44	3,056.41	176.39	308.68	440.98	926.05
Kota	272.91	477.59	682.27	1,432.77	39.32	68.81	98.30	206.43
Pesantren	108.05	189.09	270.14	567.28	125.48	219.59	313.70	658.77
<b>Total (AU)</b>	963.13	1,685.49	2,407.84	5,056.46	341.19	597.09	852.99	1,791.25

Based on table 10 above, land carrying capacity on the assumption of 20%, 35%, and 50% rice straw harvesting is the highest in Mojooroto Sub-District at 582.17 AU, 1,018.80 AU, and 1,455.44 AU. The lowest land carrying capacity in the Pesantren Sub-District was obtained by 108.05 AU, 189.09 AU, and 270.14 AU. On the harvesting assumption 20%, 35%, and 50% of corn straw, the highest was Mojooroto Sub-District with 176.39 AU, 308.68 AU, and 440.98 AU. The lowest land carrying capacity of corn straw was Kota Sub-District, each obtained as much as 39.32 AU, 68.81 AU, and 98.30 AU.

The land carrying capacity result are not sufficient for the feed needs of beef cattle in the Kediri City because beef cattle population in Kediri City is increasing. In contrast to the Sari, Liman, and Muhtarudin's research (2016) which uses the assumption of 30% and 40%, the capacity to accommodate beef cattle decreases where the carrying capacity of the 30% assumption is 107,631,146 AU and the 40% assumption is 80,723,359 AU. However, according to research by Ardiana, Widodo, and Liman (2015) that corn waste production in Braja Harjosari Village, East Lampung Regency with a usage range of

30% and 40% is not able to meet the needs of the cattle population where the population is 1,895 heads.

The potential of rice straw and corn straw in Kediri City has not been managed properly by farmers/breeders. Rice straw tends to be wasted and becomes waste that is burned every time the harvest is completed, so it is necessary to anticipate the introduction of the potential of rice straw with the concept of zero waste to farmers (Mayulu and Suhardi, 2016). The cause of land carrying capacity of rice straw so low in the Pesantren Sub-District is due to the use of 70-80% rice fields planted with sugar cane which are planted by sugar factory farmers and the rest is planted with corn because the condition of rice fields is much more suitable for corn plants than paddy.

#### 4.5. Land Carrying Capacity Index in Kediri City

The land carrying capacity is known further how the condition of wetland agriculture in Kediri City if it is adjusted to the existing criteria. The criteria for the condition of wetland agriculture are useful to see whether secure or not of wetland agriculture in Kediri City to support forage rice straw and corn straw in the future

which can be seen using the Land Carrying Capacity Index in Kediri City in table 11 below:

Table.11: Land Carrying Capacity Index in Kediri City

Sub-District	Land Carrying Capacity Index					
	Rice (DM 1,5%)			Corn (DM 1,5%)		
	20%	35%	50%	20%	35%	50%
Mojoroto	0.60	1.05	1.51	0.18	0.32	0.45
	5	8	1	3	0	8
Kota	1.62	2.83	4.05	0.23	0.40	0.58
	0	6	1	3	9	4
Pesantren	0.06	0.10	0.14	0.06	0.12	0.17
	0	4	9	9	1	3
Total	0.32	0.57	0.81	0.11	0.20	0.29
	7	3	8	6	3	0

Based on table 11 above, it shows that the results of the land carrying capacity index, both rice fields and corn fields in Kediri City have a value of  $< 1$  with very critical criteria from the total results of the calculation of the value of the land carrying capacity index, this is based on the theory of Ashari, et al (1995) which the "SAFLe" criteria has a carrying capacity index (IDD)  $> 2$ ;  $1.5 < \text{IDD} < 2$  "vulnerable" criteria;  $1 < \text{IDD} < 1.5$  "critical" criteria and  $\text{IDD} < 1$  indicates "very critical" criteria. In Kota sub-district, the index value of the carrying capacity of rice land with the criteria from vulnerable to SAFLe is the highest at values of 1,620, 2,836, and 4,051 respectively compared to other sub-districts, because the population of beef cattle in this sub-district is very small so that the need for dry matter for beef cattle sufficient. The high Food Crop Waste Carrying Capacity Index (FCWCCI) which has SAFLe criteria with values of 13.09, 7.10 and 10.96 is due to the population of ruminants in Talawaan District, North Minahasa Regency which so that the availability of nutrients exceeds the animal needs (Ismael, et al, 2018).

If the agricultural land of paddy and corn are used to meet the dry matter needs of beef cattle owned by farmers or breeders in all areas in Kediri City, it is possible that the amount of dry matter needs for beef cattle can be met every day and can cover the lack of nutritional content of elephant grass given. But in reality, rice and corn agricultural land is decreasing and the beef cattle population is increasing, causing the demand for dry matter for beef cattle to decrease in Kediri City. But in reality, paddy and corn agricultural land is decreasing and the beef cattle population is increasing, causing the demand for dry matter for beef cattle to decrease in Kediri City.

#### 4.6. Farmers and the Food Security and Agriculture Department Perceptions

##### 4.6.1. Feed Processing Equipment

The Food Security and Agriculture Department of Kediri City has provided feed processing tools such as choppers to breeders/farmers to make it easier to process forage feed efficiently and effectively in maintaining forage feed needs during the dry season. Farmers are able to process animal feed in a more efficient and sustainable way, can maintain self-sufficiency in animal feed during the dry season and can increase the productivity of their livestock products (Nisa, Aminudin, and Fahrudi, 2019).

Based on the findings in the field, only farmer groups managed by the department were given feed processing equipment and other breeders were not given due to operational cost constraints, lack of staff, etc., so that many farmers/breeders still use the conventional method of cutting forage feed using a sickle and drying under the sun. Small-scale farmers still use traditional cutting methods using sickles or other conventional farming tools and also use heating/drying methods in the sun (Yanuartono, et al, 2019).

##### 4.6.2. Business costs

Most of the breeders/farmers have difficulty in controlling the business costs to maintain the beef cattle business and eventually the farmers become bankrupt. This is due to the high price of animal feed and the lack of agricultural land in Kediri City which has resulted in a decline in forage animal feed (grass and straw). A factor causing the high cost of feed because the land used is not large enough so that the supply of grass is very limited, even the season is very influential on the availability of unstable grass and this requires farmers to buy grass in another place (Candra and Angriawan, 2020).

Happyana (2017) adds that the number of beef cattle ownership on a small scale with capital, skills and technology is still limited and traditionally managed, which has many weaknesses, including the utilization of production resources has not been maximized. In the end, the breeders/farmers in Kediri City carried out a strategy to save on animal feed costs such as planting grass on their agricultural land, adjusting the cost of feed expenditure, making and using alternative feeds such as bagasse and tofu, reducing the amount of forage feed, and taking available feed reserves.

##### 4.6.3. Economy

Breeders/farmers have very high hopes for the government Kediri City so that the government will think about their circumstances and conditions and not displace their jobs which they have been working on for  $\pm 10$  years in Kediri City. The aspect of farmers' perceptions related to farmers' expectations of the business with the length of

business of the breeder has a very real correlation or relationship than other socio-economic factors (age, education, etc.) (Muhammad, et al, 2014).

With the regional regulations made by the Food Security and Agriculture Department of Kediri City, many farmers and breeders hope that agricultural land can survive and be protected by the government so that they will continue to work in the future. In addition, the agency wants the socio-economic status of the farmers/breeders to be maintained and improved in order to create competitiveness in agricultural and livestock production, that to achieve competitiveness in Indonesian livestock production, it is necessary to empower farmers through farmer groups (Rusdiana and Soeharsono, 2019).

#### 4.6.4. Rat Pest

The decreasing of agricultural land in Kediri City has caused the snake population also decrease, because the snake's habitat has been damaged due to the many developments in Kediri City and the rat population has increased in the last 2 years. Many farmers/breeders in Kediri City often use snakes which is the best way to control rat pests on their land, that one of the efforts in controlling rats without killing by hand is related to the balance of the ecosystem between prey and predators naturally (Isnani, 2016).

The current condition of agricultural land in Kediri City is worse than in previous years so that rats are rampant which makes it difficult for farmers/breeders to deal with it and causes damage to the rice on their land. The higher the rat population, the higher the possibility of damage intensity, where 94% of the intensity of damage to rice plants due to rat attacks is determined by the level of the rat population (Priyambodo and Hidayana, 2020).

#### 4.6.5. Waste Products

Many agricultural lands have been converted to unproductive land or housing and buildings have been built, resulting in the production of agricultural waste in Kediri City, which in fact results from agricultural waste originating from the remaining production of rice and corn plants and also being used as animal feed. But farmers/breeders prefer to use field grass or elephant grass as animal feed, where the problem of optimizing the use of straw, especially soybean straw in Keerom Regency, Papua Province, among others, field grass is still quite available, lack of knowledge of farmers, increase the workload, need storage space, are not favored by livestock, and have a variety of nutrients (Usman, et al, 2015).

The high price of fertilizer every year makes farmers/breeders suffocate and cannot buy, which in the

end they sell their land to reduce fertilizer costs. But there are also farmers/breeders in Kediri City using cow dung as organic fertilizer instead of chemical fertilizers to minimize fertilizer costs, where the community can use cow dung that was previously only piled up to become valuable. more with the manufacture of organic fertilizers (Pujihartati, et al, 2021).

#### 4.6.6. Laws and Regulations

The Food Security and Agriculture Department continues to implement and oversee the regional regulation and the Omnibus Law regarding the protection of agricultural land for food in Kediri City, because the regional regulation made is based on and centered on the Omnibus Law and ministry regulations and agricultural land in Kediri City has been protected by the SAFL and RSP regulation. The protection of agricultural land is an integral part of regional spatial planning and is carried out by establishing protected food-agricultural areas, but in reality, food-agricultural lands located in urban areas also need to be protected (Freastoni and Sirajuddin, 2010).

Many farmers/breeders are not aware of the SAFL regulation and hope that agricultural land will be maintained and no land conversion is carried out so that farmers/breeders can continue to work as usual in order to maintain their socio-economic status, but land conversion still occurs due to rapid environmental changes such as a surge population, industry, housing, and others. Land conversion occurs due to pressure from other needs such as industry, housing, infrastructure development, and so on (Cahyaningrum, 2019). Chofyan, Rustan, and Hariyanto (2016) also add that there is an interest in local governments to raise funds through regional revenue, among others, by increasing the economic value of agricultural land so that land conversion for industry or settlement is considered more profitable because it generates more Land and Building Taxes higher than the agricultural sector.

#### 4.6.7. Urban Forest

Urban forests provide many benefits for the people who live in Mojoroto Sub-District, both in terms of agriculture, animal husbandry, and other matters related to community activities. The urban forest also functions as a Green Open Space (GOS) and the lungs of the city in the Mojoroto Sub-District area, especially in the Pojok village which makes the air quality there much fresher. The public as users of public GOS want the function of GOS as a shade and lungs of the city, a center for community interaction and communication (Imansari and Khadiyanta, 2015).

In addition, the people there, especially farmers/breeders, often take grass in the urban forest area



if the availability of grass decreases or dies due to chemical spraying on agricultural land. This is because the grass in the urban forest area is much fresher than the grass on agricultural land. According to Andry et al (2017), a lot of grass grows wild that has never been trimmed in urban forest areas. Farmers/breeders in Kediri City indirectly clean and add to the aesthetic value of the urban forest, keeping it clean and healthy and attractive to the eye.

#### 4.6.8. Business permit

A business permit is very necessary for everyone who wants to create or establish a business or industry, be it animal husbandry, agriculture or other industries, so that department officers in Kediri City prioritize business permits so that people can do their business safely and quietly and are protected by the city government. Department officers also provide guidance to farmers/breeders regarding business permits that are adjusted to the Environmental Impact Analysis (EIA). According to Sukananda and Nugraha (2020), Law no. 32 of 2009 concerning Environmental Protection and Management (EPM) EIA as the first basis for a business licensing system will have a major influence on environmental permits that will be issued by the government and continue on business/activity permits.

The EIA can be seen from the environmental quality standards and also the environmental feasibility assessment of the businesses/activities made by the farmers/breeders in Kediri City. Omnibus Law No. 11 of 2020 concerning Environmental Approval, environmental quality standards include water quality standards, wastewater quality standards, sea water quality standards, ambient air quality standards, emission quality standards, interference quality standards, and other quality standards in accordance with the development of science and technology. Environmental feasibility assessment is based on the value of environmental quality standards, environmental pollution, and others as the department is responsible for issuing a decision on the environmental feasibility of a business/activity for farmers/breeders listed in Government Regulation no. 27 of 1999 concerning Environmental Impact Analysis.

#### 4.6.9. Other Industries

With the conversion of this land to other industries, many people, especially farmers/breeders in Kediri City, have experienced social and economic changes, which initially they still have a traditional mindset and now turn into a materialistic mindset such as switching jobs to traders, construction workers, and etc. According to Harini and Affandi (2017) that social changes after the existence of factories or other industries have caused the village community's traditions to have shifted, the community

turned into individualism, and many immigrants, while the economic changes were narrowing agricultural land, tertiary needs being able to be fulfilled, high job mobility, and the pattern of thought changes to materialism.

Many farmers/breeders want the Kediri City government to understand which land layout mapping is good for industry or for agriculture or animal husbandry, so as not to sacrifice agricultural land to be used as industrial land or any land. The rampant industrial development followed by many newcomers working both in the industrial and other sectors resulted in an increasing need for housing. This is the same as the current condition of Kediri City where there are many changes or conversions of land or land used as industries and residences, for example housing because of the large number of immigrants (Niandyti, Sufyandi, and Utami, 2019).

#### 4.6.10. Food security

Food security which was proclaimed by President Joko Widodo and Vice President Jusuf Kalla in 2014 – 2019 wants agricultural development in the future, so that the department, especially the Food Security and Agriculture Department of Kediri City, provides guidance to farmers/breeders regarding food security which is regulated by law and Ministry Regulations. Strengthening food security towards food self-sufficiency by increasing staple food production, stabilizing food prices, ensuring safe and quality food prices with increased nutritional value and increasing the welfare of food business actors (Nurkayani, Setyowati, and Sandyatma, 2015).

The farmers/breeders in Kediri City are very positive about the SAFL regulations from the department and also the rules from the central government, but they expect the city government to be more transparent to them so that they know about land mapping and also get information. In addition, it can regulate several sectors and there is no confusion in the regulations so that farmers/breeders can survive. This is an inhibiting factor for those who find it difficult to maintain their agricultural land, resulting in land conversion. According to Dekasari (2016), the inhibiting factors are that many human resources lack knowledge, lack of capital to improve their farming business, and weather factors that are very influential in running their farming business.

#### 4.6.11. Laboratory

The future plan of the Food Security and Agriculture Department of Kediri City is to build an animal husbandry laboratory to carry out tests or tests on animal feed, animal health, animal products, and wants to reduce the cost of laboratory expenses that are often carried out and sent to the Provincial Animal Husbandry Service. East

Java. According to Iqbal (2011) that animal health services include veterinary laboratory services, veterinary examination and testing laboratory services, veterinary medical services, and/or services at the Animal Health Center (AHC). The department officers already know that in the future animal husbandry in Kediri City is very difficult to develop and agricultural land is also starting to decrease, so they prioritize animal health over livestock.

#### 4.6.12. Agricultural land

Agricultural land in Kediri City is decreasing every year due to the conversion of land to be used as industrial development, housing, and others so that it affects the amount of animal feed taken. The Food Security and Agriculture Department of Kediri City establishes SAFL regulations for the mayor and the Regional People's Representative Council (RPRC) to protect agricultural land. Through the establishment of SAFL regulation policies, the economic conditions and policies in the region must take into account and these rural area institutions can also manage SAFL incentives that will be received by farmers (Kusumastuti, Kolopaking, and Barus, 2018).

The existence of the agricultural land conversion due to those farmers/breeders in Kediri City sell their land on the grounds of family economic constraints and uncertain incomes, besides that they also have concurrent professions as construction workers or factory workers. There are also some farmers concurrently or have other livelihoods such as teachers and traders, farmers' income has not changed and the rice fields are no longer productive for agricultural land because they often experience crop failure (Hendrawan and Dewi, 2016).

Farmers/breeders really hope that agriculture must be integrated with animal husbandry, because the integration between agriculture and animal husbandry will bring maximum results because animal husbandry cannot be separated from agriculture where all animal feed such as grass and agricultural waste comes from agricultural land. Chaniago (2015) said that the integration pattern is feasible to develop because it increases farmers' income and reduces production costs compared to farming activities that have been carried out by farmers.

#### 4.6.13. Employment Opportunities

The loss of agricultural land in Kediri City also has an impact on the loss of community jobs as farmers, causing the number of farmers/breeders in Kediri City decreasing, other factors are socio-economic, and government policy factors. The socio-economic factors experienced by them are the low level of education they have from elementary to junior high school, but there are also those that support high school education to postgraduate education. According to Rahman, Kusuma, and Arfyanto

(2020) that the lower the education level of workers, the more limited their choice of work in low-skilled groups, thereby increasing their vulnerability in the labor market.

Families of farmers/breeders do not want to continue their family-owned business because their sons prefer clear jobs and fixed incomes such as factory workers, traders, travellers, and others, and some of their children are still child. Susilowati (2016) said that the declining interest of young workers in the agricultural sector has consequences for the sustainability of the agricultural sector in the future, namely the burden of the agricultural sector is getting heavier with the increase in population and food demand.

Government policy factors also affect the loss of job opportunities for farmers/breeders which government policy can change the spatial arrangement of the area in Kediri City depending on the needs or interests which according to the government should be increased or reduced. According to Arvianti, et al (2019) that the number of residents in cities from year to year continues to increase by 4%, if this continues, agricultural land which is generally located in villages will be increasingly abandoned.

#### 4.6.14. Animal Feed

The efforts of the city government, especially the Food Security and Agriculture Department of Kediri City, are to use dry agricultural land or moor as forage planting land and provide guidance on forage feed processing, both about storage, preservation, and feed technology to farmers/breeders. The efforts made are storing, preserving, and improving the quality or nutritional value through a touch of feed technology. Efforts like this are a solution for farmers/breeders who have difficulty finding animal feed, especially forage (Sari, Liman, and Muhtarudin, 2016).

The farmers/breeders prefer the traditional method which is often done by them every day, because this method is much more efficient and less complicated. There are also farmers/breeders who use feed processing technology in order to cut costs and time spent so they don't worry if the dry season arrives. The ability of the community to overcome the problems they face independently is the main indicator of increasing income and living welfare (Kleden and Nenobais, 2018).

Whereas in Kediri City, the potential for agricultural waste is quite high and it is possible to provide sufficient feed for ruminants, especially beef cattle. The department officer has also held outreach and guidance on feed ingredients in Kediri City to farmers/breeders. The socialization is carried out by providing knowledge about local feed ingredients such as agricultural waste which is very abundant and cannot be maximized for its use as

ruminant feed (goats, sheep, and cattle) (Purnamasari, etc., 2020).

Although farmers/breeders in Kediri City often experience a shortage of forage feed, they don't feel any trouble to find and obtain forage feed, because they can take it on land owned by their own family or belonging to a farmer group and can even be taken on vacant land, so they rarely use agricultural waste. Accessibility based on the origin of the feed is easy, because the feed used to meet the needs of livestock comes from their own land in the form of yards, rice fields, and fields managed by farmers to grow food crops and animal feed (Handayanta, Rahayu, and Wibowo, 2015).

#### 4.6.15. Development

Many farmers/breeders strongly oppose the existence of developments such as warehouses, industries, and others on their agricultural land, but they are powerless and cannot go against the rules from the government. According to Pujiwati and Rubiati (2017), land acquisition for the public interest must be carried out by the Government and the land is then owned by the Government or Regional Government.

This could be due to farmers/breeders selling their land in order to maintain their family's economy or the government focusing on the public interest to improve the welfare of its people but sacrificing agricultural land in their cities. Farmers were forced to give up their rice fields being evicted on the grounds that the village government intervened which was considered to be of little help to the housing sector in building housing on agricultural land owned by residents (Hendrawan and Dewi, 2016). Kusumastuti, Kolopaking, and Barus (2018) add that the price of land around development areas and areas that are transformed into cities will increase so that land owners are tempted to sell or convert their land.

#### 4.6.16. Government

The SAFL regulation made by the government, especially the Food Security and Agriculture Department of Kediri City, is intended to empower and protect the community, so that they continue to carry out their duties such as farmers or ranchers and are safe and comfortable in carrying out their daily lives. According to Satria, Falatehan, and Beik (2018), the concept of community empowerment means placing the community and its institutions as the basic force for economic, political, social and cultural development and acting as a locomotive for economic progress.

In addition, most of them are people who are less well off in terms of economy, food, clothing, education, and others who only seek economic justice from the city

government so that the government pays attention and sees their condition firsthand. In article 5 of Law no. 16 of 2011, poor people or groups of poor people are people who cannot fulfill basic rights properly and independently, such as: the right to food, clothing, health services, education services, work and business, and/or housing (Raharjo, Angkasa, and Bintoro, 2015).

Farmers/breeders also hope that there will be special protection for farmers/breeders as well as access to provide advice to the government. Bachtiar (2016) said that the guarantee of protection is directed to the existence of access to justice for justice seekers, especially for those who cannot afford it, through a legal instrument that opens space for them to obtain their constitutional rights, namely the right to legal aid.

#### 4.6.17. Protection

The farmers/breeders in Kediri City really want not only agricultural land to be protected and maintained, but also farmers and ranchers also need protection in order to make it easier for them in any way. This SAFL regulation has included protection of both the protection of agricultural land as well as the protection of farmers and breeders as stated in Article 30 paragraphs 5 and 6 and Article 31 paragraphs 1 and 4 where the government has prepared compensation and guarantees for the conversion of agricultural land in Kediri City to agriculture land owners by providing replacement land equal to 3x the area of land previously owned. According to Carlisle, et al (2019), incentive or compensation programs to protect land and provide more for farmers have also been piloted at the state level.

In the agricultural policy contained in this SAFL regulation, the city government applies three (3) approaches to the protection of agricultural land, namely the regulatory approach, the community group approach, and the economic approach. According to Tanentzap, et al (2015) are 1) a regulatory approach that can be enforced through penalties and conditions provided for financial support to farmers, 2) a community-based approach that supports farmers and local stakeholders, and 3) an economic instrument approach, which pays farmers directly or create markets to adopt practices that minimize environmental impact and provide non-commodity outputs.

In fact, apart from the establishment of SAFL regulations related to the agricultural land protection and the socio-economic status of farmers/breeders, the city government's main objective is to implement modern animal husbandry in Kediri City in the future on farms owned by farmers/breeders. Hasibuan (2016) says that economic opportunities take advantage of every profitable opportunity while its manifestations vary in various

regions according to agricultural patterns and cropping patterns. Even though there are SAFL regulations, farmers/breeders are also expected not to sell their agricultural land and continue to support the government's efforts to realize and run these regulations smoothly.

#### 4.6.18. Farmers and Breeders

The Kediri City Government through the Food Security and Agriculture Department often provides guidance to farmers/breeders regarding business permits and convinces them of the regional regulation and the Omnibus Law, so that they do not take the wrong steps. However, the department officer only provides guidance to groups of farmers/breeders formed by the service, other than that, farmers/breeders outside the group do not get it. In the social reality in society, it cannot be ruled out that certain circumstances make not all groups in society easily feel welfare, including the opportunity to get justice (access to justice) (Bachtiar, 2016).

The absence of guidance that is spread evenly to all layers of farmers/breeders in Kediri City, causing them to be difficult to progress and unable to develop their mindset and work due to lack of guidance from the department officer. In article 40 of Law no. 19 of 2013 concerning Protection and Empowerment of Farmers where farmer empowerment is carried out to promote and develop the mindset and work of farmers, improve farming, and require and strengthen farmer institutions to be independent and highly competitive (Pujiwati and Rubiati, 2017).

The farmers/breeders hope that the SAFL regulations can run well and smooth as well as the protection of farmers, because it will be very difficult for them to find and obtain daily necessities such as food, household needs, and others due to changes in land use in Kediri City. Most people allocate their income to fulfill secondary needs for one month, namely electricity tax needs, social needs, and consumption of fuel oil needs (Mahardika and Muta'ali, 2018).

#### 4.6.19. Beef Cattle Farm

Animal husbandry, especially beef cattle farming, cannot be separated from agricultural land, both wetland and dryland in terms of animal feed obtained. If beef cattle farming in Kediri City is integrated with agriculture, maximum results will be obtained and both rely on one another. In regional development, an appropriate physical environment needs to be supported by the availability of forage for animal feed and the amount of forage production in the region related to the animal holding capacity (Suhaema, Widiatmaka, and Tjahjono, 2014).

Ownership of agricultural land and beef cattle farms owned by farmers/breeders in Kediri City is land that has been handed down from generation to generation by their families. For those who have narrow land and they cannot fulfill their needs economically, they sell their land to meet their daily needs. Smallholder farmers tend to sell their land because the income earned from the land is not sufficient for their household needs (Arifin, Azizah, and Irdaf, 2017). They are just hoping that the city government will not carry out construction on fertile land so that they can survive and work on their land for the needs of their families.

Most of them work as farming which is their main job compared to livestock where raising livestock is only for their family's savings and on average have 1 – 5 beef cattle, so they don't focus on it unless there are some breeders who actually do livestock farming as their main job so as not to break down or stop. The purpose of maintenance as a main business and as savings to finance children's studies (Otoluwa, et al, 2016). Isyanto (2015) added that farmers who have non-agricultural main jobs will certainly devote more time to their main job, especially if the income contribution from the beef cattle fattening business is smaller than the income contribution from their main job.

#### 4.6.20. Farm Pollution

Currently, beef cattle farms in Kediri City often experience problems, namely the problem of pollution of beef cattle farm waste such as odor pollution, wastewater, and others. The Food Security and Agriculture Department of Kediri City has a goal, namely wanting to create and build modern farms, both poultry and ruminant farms in the future. It aims to reduce pollution from smallholder farms which often cause problems. The farmers/breeders in Kediri City are already good at handling waste and there is no smell of sewage in their cattle pens, although there is still sediment from cow dung mixed with water and cow urine that settles. According to Romansah (2020) that if in this case the waste is directly disposed of through waterways or sewers and then enters the environment without first going through a processing process, then water and soil pollution cannot be avoided.

## V. CONCLUSION

Kediri City is not feasible and cannot develop a beef cattle business in the future because agricultural land, both wetland and dryland agriculture, is decreasing when seen from the results of mapping wet land and dry land in 2014 and 2019. In this land suitability mapping, Kediri City is very suitable for paddy fields and moor as forage-producing land and deserves to be developed for each area except in the area around Mount Klotok and Mount

Maskumambang, Mojoroto Sub-District which has different soil types, types of slopes, and slopes. The land carrying capacity for forage feed, especially rice straw and corn straw on all land in Kediri City with very critical criteria so that it is not able to support the need for dry matter in beef cattle feed in Kediri City.

The estimated production of elephant grass in Kediri City which is in the urban forest of Mojoroto Sub-District is fairly high, while the production of elephant grass on agricultural land owned by farmers/breeders can be said to be of medium production per year. Utilization of agricultural land in Kediri City when viewed from the perceptions of farmers/breeders and Food Security and Agriculture Department are feed processing equipment, business costs, economy, rat pests, waste products, laws and regulations, urban forests, business permits, other industries, food security, laboratories, agricultural land, employment opportunities, animal feed, development, government, protection, farmers and breeders, beef cattle farm, and farm pollution.

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## Analysis and elaboration of lemon balms teas (*melissa officinalis l.*) in São Gabriel da Cachoeira-AM

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**Keywords**— *Lemon Balm, Medicinal Tea, São Gabriel da Cachoeira, Sensory Analysis.*

**Abstract**— *The diversity of plants in the Alto Rio Negro region and the traditional knowledge of indigenous peoples on the consumption of medicinal plants for the cure of diseases are factors that justify the need to expand knowledge about these practices, especially about forms of consumption. The IFAM CSGC carried out the research on sensory analysis with the Institution's workers and students, evaluating the Lemon Balm species (*Melissa Officinalis L.*), aiming to prepare and evaluate the Lemon Balm tea by the academic community of the IFAM Campus São Gabriel da Cachoeira, Amazonas. Tea is the most consumed food for the treatment of various illnesses in the region, mainly as a natural tranquilizer. To prepare the tea, three techniques were used: infusion, decoction, and maceration. For the sensorial analysis, the hedonic scale was used, according to the methodology of Monteiro (1984). The research on Lemon Balm tea resulted in high levels of sensory acceptability, highlighting the infusion technique by workers, and the decoction technique among students, in which the "age" factor may have influenced the results, as adult individuals tend to show loss of some organoleptic characteristics such as aroma and flavor, and young individuals do not yet have these characteristics fully developed.*

### I. INTRODUCTION

São Gabriel da Cachoeira, located on the border with Colombia and Venezuela, in the extreme northwest of Brazil, is a city in the state of Amazonas. Considered the most indigenous city in Brazil, it comprises 23 indigenous peoples (Gomes, 2013). Inside this multicultural city is located the Federal Institute of Amazonas Campus (Instituto Federal do Amazonas IFAM/CSGC) where this study was conceived and carried out. The IFAM/CSGC has the mission of integrating indigenous and non-indigenous people, bringing education to all ethnic groups in the Alto Rio Negro region, as a right guaranteed in the Federal Constitution of 1988. It has been carrying out

teaching, research, and extension activities since 1994, the year of its foundation, promoting educational policies for differentiated education that meets the demands of local society (IFAM CSGC, 2021).

With Alto Rio Negro's region biodiversity and the traditional knowledge of indigenous people on the consumption of medicinal plants for the cure of diseases, there is the need to expand knowledge, mainly for forms of consumption such as teas, baths, bottles, syrups, among others.

According to Barbosa and Cazal (2018), tea is the second most consumed food in the world, second only to water, which has the first place. Its consumption has

historical records since antiquity, when people already used the plants to heal disorders, dysfunctions, and diseases. In accordance with the Institute of Food Technologists (IFT, 1981), sensory analysis is a discipline of science that measures, analyzes, and interprets properties of materials or foods through the human body's senses, such as taste, smell, touch, hearing, and vision. According to Nascimento (2014), although some organoleptic properties are realized by the same sense of the human body, its definitions may not have the same meaning as the "taste" and "flavor". For example, the taste is a characteristic perceived only by the palate, while the flavor requires a sensory analysis carried out by the olfactory receptor cells, taste buds, tactile and thermal elements of the tongue, in addition to the oral cavity. The "aroma" is characterized by the perception of volatile substances by smell, retronasally (Nascimento, 2014). When sensory analysis evaluates two or more properties, it is called "flavour" (Esteves, 2009).

Melissa (*Melissa officinalis* L.), known as melissa, a true lemon balm that belongs to the Lamiaceae family, is of Asian and European origin (Meira et al., 2012). This plant is composed of hydroxycinnamic acid and essential oils, especially terpenoids such as citral, citronellal, geraniol, and nerol, in addition, it consists of flavonoids and tannins (Silva et al., 2018). It has simple, opposite leaves, with a serrated edge; pinkish-violet inflorescences gathered in an axial chapter of a short and variable axis. The fruits are globose drupes (Vieira et al., 2016, p.103). The plant gives off a lemon-like odor that gets more intense after the plant dries. Popularly used to treat nervous breakdowns, tachycardia, melancholy, hysterics, and anxiety. The essential oil of this plant is in the leaves and flowers (Meira et al., 2012).

This study aimed to prepare and evaluate, through sensorial analysis, the lemon balm tea by the academic community of IFAM São Gabriel da Cachoeira campus, Amazonas state, Brazil.

## II. METHOD

### *Acquisition of Raw Materials*

The Lemon Balm species (*Melissa officinalis* L.) was cultivated and extracted on the Medicinal Plants Nursery of IFAM - São Gabriel da Cachoeira campus. The taxonomic identification of the seedlings was performed with the help of the biology technician according to the cataloguing of the Herbarium Control System (Sistema de Controle de Herbário - SICOHE) and the Amazonas Research Institute (Instituto de Pesquisa do Amazonas INPA).

### *The tea preparation (methodologies, and techniques)*

The tea preparation was made by three different techniques after sanitizing the plant material with water and soap, and selection of the healthiest leaves of the plant species that were used. For the infusion technique, 50g of lemon balm leaves were previously separated, cut in little pieces and put into a metallic container where there was 500ml of boiled water at 100° C. The recipient was closed and left to rest for about 10 to 15 minutes. For the Decoction technique, 50 g of the plant material was cut and put into a metal container where there was 500 ml of water in regular temperature. After that, the recipient was brought to the fire until the boiling temperature of the water reached. After boiling the water, the system was left on the fire for 8 minutes and then putted to rest until it reached the regular temperature again. For the Macerated technique, 50 g of plant material was cut, crushed and placed in 500 ml of water at room temperature for 24 hours. By the end of this process, the products were filtered in a paper strainer and transferred to properly identified thermal bottles.

### *Sensory Analysis*

Sensory acceptability tests were performed based on the analysis of sensory attributes: appearance, smell, colour, taste, texture and global acceptance, through a structured hedonic scale of nine extreme points (1- I really disliked it) and (9- I liked it a lot), according to Monteiro's methods (1984). It also verified the frequency of consumption with extremes by (1- I would only eat this if I was forced to) and (9 - I would eat this whenever I had the opportunity), with the IFAM-CSGC students and public servers. The sensory analysis of tasting was made by the Organic Chemistry Laboratory (IFAM-CSGC).

110 tasters untrained of both sexes with different ages students or servers participated in this study (TAE and teachers) from IFAM-CSGC.

The samples were presented to the evaluators in disposable plastic cups, coded with random numbers without the identification of the product. The collaborators agreed to participate in the research voluntarily and they were instructed to sign the Informed Consent Form (Termo de Consentimento Livre Esclarecido TCLE).

The data from sensory analysis were submitted to descriptive statistics through @Microsoft Excel Version 2010.

## III. DISCUSSION AND RESULTS

The consumption of medicinal and aromatic plants is generally through the ingestion of drinks like teas, for example. Characteristics such as great smell and taste

contributed to the popularization of this drink, but due to its medicinal properties is that it spread across different cultures (Braibante et al., 2014). The active ingredients of the tea are absorbed through the digestive tract, going through the hepatic circulation, according to its physical and physicochemical properties until it is metabolized by the liver and transformed into an easily eliminated substance. Despite the herbal benefits, Cardoso (2012) says that tea consumption must be encouraged, not only because of the therapeutic need, but because of sensory experiences that drinking it can bring to its users.

From the results of this research, it was possible to verify the potential of Lemon balm tea ingestion by IFAM-

São Gabriel da Cachoeira campus students and servers. The Table 1 shows sensory analysis, consumption frequency, purchase intention and purchase acceptance index by the institution's servers. Sensory analysis demonstrated that the consumption frequency was much

higher when the tea was prepared in the infusion form (82,38%). Regarding the purchase intention, the highest averages were also verified for manipulation through infusion, classifying the tea in the category "I would probably buy it" in the evaluation of the servers. In a study conducted by Nascimento (2014), 'black tea' was prepared in different ways and the infusion technique was more preferred than the others by the panel of evaluators.

Table. 1: Sensory analysis rate ( $\pm$  standard deviation), consumption frequency, and purchase intention of the 'lemon balm' tea by the IFAM servers

Characteristics	Pontuation	Servers Samples		
		Infusion	Decoction	Maceration
Appearance	(1-9)	Lemon Balm 7.61 $\pm$ 1.18	Lemon Balm 7.26 $\pm$ 1.37	Lemon Balm 7.41 $\pm$ 1.67
Smell	(1-9)	7.87 $\pm$ 1.39	7.13 $\pm$ 1.59	7.43 $\pm$ 1.39
Colour	(1-9)	7.12 $\pm$ 1.59	7.13 $\pm$ 1.36	7.12 $\pm$ 1.58
Taste	(1-9)	7.15 $\pm$ 1.69	6.38 $\pm$ 1.89	6.92 $\pm$ 1.86
Texture	(1-9)	7.25 $\pm$ 1.71	6.62 $\pm$ 1.98	7.34 $\pm$ 1.59
Global Acceptance	(1-9)	7.46 $\pm$ 1.66	6.36 $\pm$ 2.15	7.21 $\pm$ 1.83
Consumption Frequency	(1-9)	6.64 $\pm$ 1.78	5.74 $\pm$ 1.89	6.50 $\pm$ 2,00
Purchase Intent	(1-5)	4.33 $\pm$ 0.86	3.68 $\pm$ 1.19	4.20 $\pm$ 1.50
Acceptance index	(%)	82.38	75.68	80.48

Source: Search Results.

Regarding the acceptability for the sensory attributes' appearance, smell, colour, taste, texture, and global acceptance (Figure 1), it was found that all characteristics had an acceptability index higher than (70%).

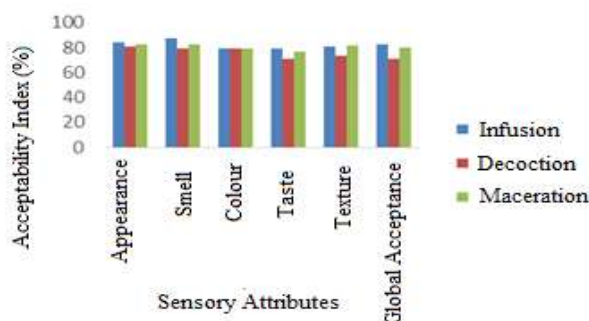


Fig. 1: Acceptability index by sensory attributes of 'lemon grass' tea, by servers  
Source: Search results

In Castro's et al. (2007) evaluation, for a product to be accepted by the consumer public, its sensory evaluation must be at least 70%. Therefore, regardless the technique employed, lemon balm tea was accepted by the evaluators and that means the product classification in categories "I liked it slightly" and "I liked it moderately". In the sensory evaluation of ginger inflorescence tea, Lucio et al. (2010), it was found an acceptability index higher than (80%), and it was considered, that the ginger inflorescence may be yet another alternative of nutritious food available on the market for consumers.

In the sensory evaluation performed by the students (Table 2) the lemon balm tea was better manipulated by the decoction technique. About the acceptability index it was (70,97%). The Consumption Frequency was classified at the "I would eat it if it was affordable, but I would not strive" category. This perception by the students may be related to the fact that the tea was served without the

addition of sweeteners, which contributed to the intensification of sensory attributes. Regarding the purchase intention, the students informed that they 'would have doubts whether they would buy' the tea, if it was being marketed.

In Steinle's et al. (2005) research it was not possible to find any significant differences in sensory acceptance of

mate tea sweetened with sucrose, aspartame, and stevia before and after physical exercise. Barboza and Casal (2018) evaluated the influence of sensory factors and nutritional knowledge on the acceptance of mate tea. They stated that the non-addition of sweeteners in this beverage influenced the sensory evaluation, because most of the consumers prefer tea with sugar.

Table. 2: Sensory analysis rate ( $\pm$  standard deviation), consumption frequency, and purchase intention of the 'lemon balm' tea by the IFAM students.

Characteristics	Pontuation	Students Samples		
		Infusion	Decoction	Maceration
Appearance	(1-9)	Lemon Balm 6.58 $\pm$ 1.91	Lemon Balm 6.56 $\pm$ 1.79	Lemon Balm 6.66 $\pm$ 1.82
Smell	(1-9)	5.25 $\pm$ 2.45	6.17 $\pm$ 2.29	5.87 $\pm$ 2.50
Colour	(1-9)	6.52 $\pm$ 1.72	6.68 $\pm$ 1,70	6.22 $\pm$ 1.89
Taste	(1-9)	5.35 $\pm$ 2.61	6.04 $\pm$ 2.28	5.76 $\pm$ 2.47
Texture	(1-9)	5.76 $\pm$ 2.43	6.32 $\pm$ 1.87	5.90 $\pm$ 2.05
Global Acceptance	(1-9)	6.29 $\pm$ 2.12	6.55 $\pm$ 2.10	5.95 $\pm$ 2.39
Consumption Frequency	(1-9)	5.35 $\pm$ 2.23	5.73 $\pm$ 2.25	5.67 $\pm$ 2.26
Purchase Intent	(1-5)	3.68 $\pm$ 1.25	3.57 $\pm$ 1.17	3.60 $\pm$ 1.30
Acceptance index	(%)	66.25	70.97	67.37

Source: Search Results

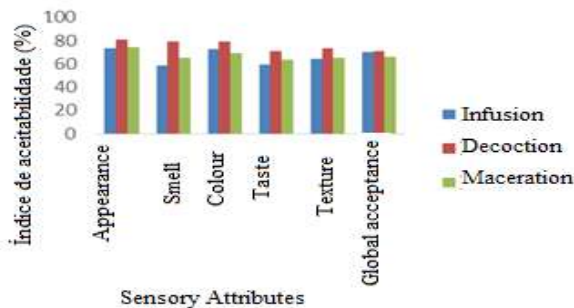


Fig. 2: Acceptability index by sensory attributes of 'lemon grass' tea, by students  
Fonte: Search Results.

The sensory acceptability index of the attributes (appearance, smell, colour, taste, texture and global acceptance) is higher than (50%) regardless of the technique used (Figure 2). It is noticeable that in the decoction technique the attributes had the highest indices with numbers higher than (70%). Carvalho et al. (2006), states that sensory analysis is an important technique for knowing the consumer's opinion and purchase intent in relation to a particular product. Santos et al. (2016) added

inulin in green tea cake and reached acceptability rates of more than 70%.

#### IV. CONCLUSION

The Lemon Balm tea showed a huge potential for consumption by IFAM-Campus São Gabriel da Cachoeira - AM servers and students. On this research, the different methods had high levels of sensory acceptability. The servers considered the infusion technique the best for the tea preparation, while the students thought that the decoction is the best technique. It is really likely that the age was a factor that influenced on the results. The adults tend to present organoleptic loss (smell and taste), while young people do not have these fully developed characteristics.

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## Spatio-temporal dynamics of land use in the municipality of Tori-Bossito in southern Benin

## Dynamique Spatio-Temporelle De L'occupation du Sol Dans la Commune de Tori-Bossito au Sud-Benin

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**Keywords—** Tori-Bossito, Spatio-temporal  
dynamics, Degradation, GIS.

**Mots clés—** Tori-Bossito, Dynamique spatio-  
temporelle, Dégradation, SIG.

**Abstract—** The municipality of Tori-Bossito in southern Benin has been experiencing a change in its natural environment for several decades. It is important to understand it for a better development. The purpose of this study is to analyze the spatio-temporal dynamics of land use in this municipality from 1990 to 2018. The method adopted is based on the diachronic analysis of land use from Landsat images of 1990, 2000 and sentinel 2A of 2018. The cartographic results allowed the establishment of land use maps of the municipality and to carry out area calculations and curves. The analysis of the dynamics of land use shows an evolutionary trend of essentially regressive plant formations. The portions of fields and fallow land under palm trees fell from 22,409 ha in 1990 to 2,026 ha in 2018, i.e. a regression rate of 62.14%. On the other hand, crop and fallow mosaics increased from 9,213 ha in 1990 to 27,611 ha in 2018 with a growth rate of 55.09%. The agglomerations varied from 316 ha in 1990 to 2082 ha in 2018 or 5.38%. All this leads to a change in the landscape. The factors of this degradation are the increase in population, the development of agricultural activities especially the production of pineapple, the proximity of the commune to the economic capital of Benin and the establishment of adequate road infrastructure.

**Resumo—** La commune de Tori-Bossito au Sud-Bénin connaît depuis quelques décennies une modification de son milieu naturel. Il importe de l'appréhender pour un meilleur aménagement. La présente étude a pour but d'analyser la dynamique spatio-temporelle de l'occupation des sols dans cette commune de 1990 à 2018. La méthode adoptée est basée sur l'analyse diachronique de l'occupation des terres à partir des images Landsat de 1990, 2000 et de sentinelle 2A de 2018. Les résultats cartographiques ont permis l'établissement des cartes d'occupation des sols de la commune et de réaliser des calculs de superficie et des courbes. L'analyse de la dynamique de l'occupation des sols montrent une

*tendance évolutive des formations végétale essentiellement régressive. Les portions des champs et jachères sous palmiers sont passées de 22409 ha en 1990 à 2026 ha en 2018, soit un taux de régression de 62,14%. Par contre, les mosaïques de cultures et jachères sont passées de 9213 ha en 1990 à 27611 ha en 2018 avec un taux de progression de 55,09%. Les agglomérations ont varié de 316 ha en 1990 à 2082 ha en 2018 soit 5,38%. Tout ceci entraîne une modification du paysage. Les facteurs de cette dégradation sont l'accroissement de la population, le développement des activités agricoles surtout la production de l'ananas, la proximité de la commune avec la capitale économique du Bénin et la mise en place d'infrastructures routières adéquates.*

## I. INTRODUCTION

A l'instar de tous les pays d'Afrique subsaharienne, le Bénin est confronté à un défi commun qu'est l'explosion démographique (L. D. Ahomadikpohou, 2015, p.13), avec un taux d'accroissement de sa population de l'ordre de 3,2 % (INSAE, 2013, p.13). Ces mutations démographiques entraînent l'accroissement des besoins alimentaires. Cette situation s'est traduite par l'augmentation des superficies emblavées au détriment des formations naturelles (A. Kissira, 2010, p.14). On assiste à la conversion de plus en plus accrue des savanes et forêts en champs et pâtures en milieu tropical (J. B. Gnanho, 2016, p.12). L'augmentation des surfaces cultivées étant fonction de la croissance démographique, il s'en suit un recul de la jachère, une saturation de l'espace rural et une dégradation générale des sols (M. Gibigaye, et al., 2015, p. 265). Cette dégradation est due notamment aux mauvaises pratiques culturales (A. M. Maman Tondro, 2019, p. 11). Pour accroître leur production, les agriculteurs utilisent des stratégies de maximisation des rendements agricoles telles que l'augmentation des emblavures, l'utilisation accrue des engrais. Le déboisement induit un changement de l'occupation des sols, une transformation des écosystèmes naturels et par conséquent une perte potentielle du capital productif naturel. Il entraîne également une fragmentation des écosystèmes, la perte de connectivité et l'isolement des habitats naturels par les cultures et les infrastructures, limitant la satisfaction des besoins vitaux de la faune et de la flore en termes de déplacements et de dispersion et participe ainsi à l'érosion de la biodiversité et à la dégradation des habitats naturels concernés (Alohou et al., 2016). Les systèmes d'utilisation de l'espace sont très complexes. Cette complexité provient des dynamiques spatio-temporelles, du nombre important d'acteurs intervenant dans cette dynamique (A. M. MamamTondro, 2019, p.10).

Les changements d'occupation des sols dans la Commune de Tori-Bossito ont pris une ampleur sans précédent depuis les dernières décennies. L'espace rural de la Commune

devient alors une importante préoccupation, car les populations rurales en dépendent.

Le présent travail se propose, à partir du système d'information géographique (SIG) et de la télédétection, de cartographier l'occupation des sols de la commune et d'appréhender l'évolution dans le temps et dans l'espace des unités paysagères en vue de faciliter la planification et la gestion des territoires ruraux dans la commune de Tori-Bossito au Sud Bénin.

Pour comprendre la dynamique de l'occupation des sols dans la sous-région ouest-africaine, divers auteurs ont utilisé conjointement les méthodes de système d'information géographique (SIG) et la télédétection (Koumoï et al. 2013 ; Avakoudjo et al., 2014 ; Gildas et al., 2016 ; Azandégbé et al., 2019 ; Biga et al., 2020).

## II. MATERIEL ET METHODE

### 2.1. Présentation de la zone d'étude

La commune de Tori-Bossito est située dans le département de l'Atlantique au Sud-Bénin sur une superficie de 263 km<sup>2</sup>. Elle est comprise entre 6°26'17'' et 6°36'43'' de latitude nord et 2°01' et 2°15'30'' de longitude est. La commune est divisée en six arrondissements (Avamè, Azohouè-Aliho, Azohouè-Cada, Tori-Bossito, Tori-Cada et Tori-Gare) composés de cinquante-huit villages et quartiers de ville.

Sur le pan physique, son relief est constitué d'une zone de plateau au nord, à l'ouest et au centre, d'une zone de vallée à l'est et d'une zone de dépression au sud traversant l'arrondissement d'Avamè et se prolongeant dans l'arrondissement de Tori-Cada, jusqu'aux environs de Gbétaga. Ses altitudes varient de 79,2% à 0,8%. Le caractère peu accidenté du relief, offre à la commune de Tori-Bossito de vastes superficies cultivables, ce qui favorise le développement des activités agricoles, sources de la dynamique des composantes environnementales, notamment le sol et la végétation.

Le climat de la zone d'étude est de type subéquatorial avec une alternance de deux saisons sèches et de deux saisons pluvieuses. Les pluviométries annuelles varient entre 900mm et 1100mm.

Les sols qui caractérisent la commune de Tori-Bossito sont essentiellement de type ferrallitique sur terre ferme et hydromorphe par endroits en milieux marécageux. Ils sont dans l'ensemble fertiles et exploités en toute saison.

Le réseau hydrographique à Tori-Bossito est peu fourni. Il est constitué essentiellement de marécages qui, en période hivernale forment de véritables plans d'eau. Ces marécages qui prennent leur source dans Aoutè (Commune d'Allada) traversent les arrondissements d'Avamè et de Tori-Cada essentiellement, mais aussi ceux de Tori-Gare. Ce réseau hydrographique est fortement utilisé aujourd'hui par les exploitants agricoles, qui, dans leurs mutations

agricoles, se sont penchés massivement vers le maraîchage.

Sur le plan écologique, la commune de Tori-Bossito appartient à la zone agro-écologique 7 de terre de barre dont les principales spéculations sont le maïs en tête de rotation, le manioc, le niébé et l'arachide.

La population constituée majoritairement du groupe socioculturel Toli (84%) est estimée à plus de 64632 habitants en 2020. Sur une superficie de 264 km<sup>2</sup>, La densité de la population a évolué de façon progressive. Elle est passée de 110,66 habitants/km<sup>2</sup> en 1992 à 132,16 habitants/km<sup>2</sup> puis à 175,69 habitants/km<sup>2</sup>.

L'agriculture est la première activité des populations. Le maraîchage est également pratiqué dans les zones marécageuses.

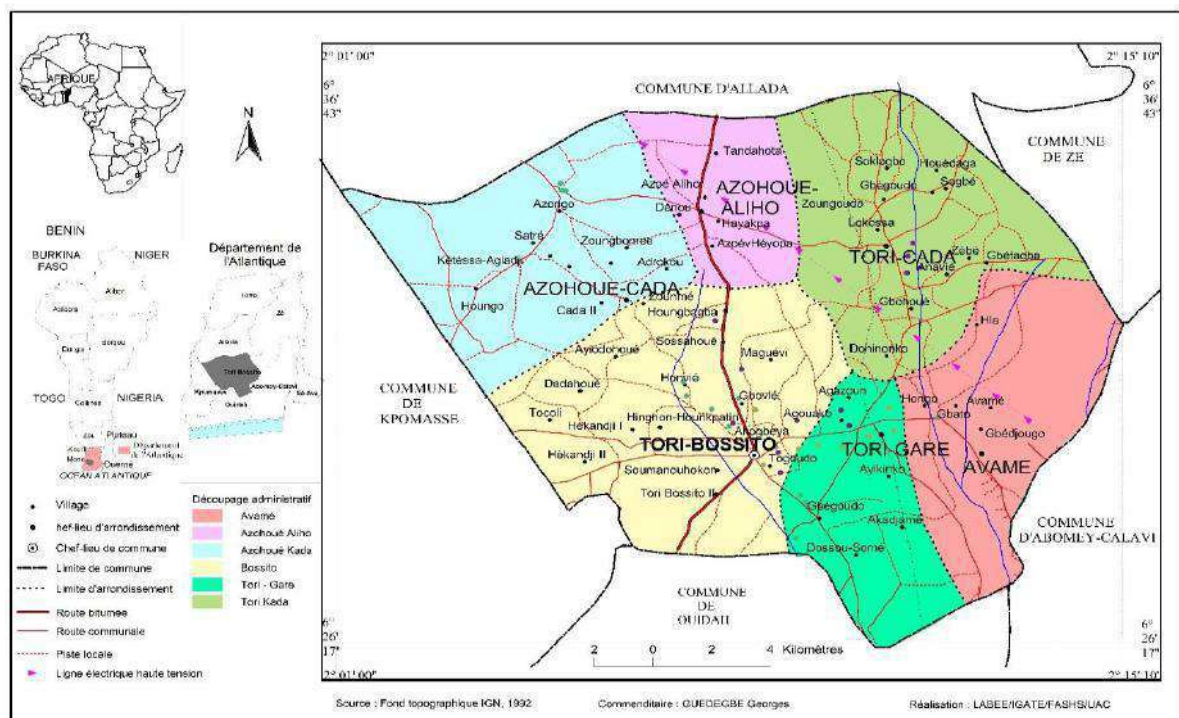


Fig.1: Situation géographique de la Commune de Tori-Bossi

## 2.2. Démarche méthodologique

La démarche méthodologique adoptée est basée sur une approche cartographique, analytique et diachronique basée sur l'utilisation de la télédétection et des systèmes d'information géographique SIG. Elle se présente en 3 étapes à savoir : l'acquisition des données, le traitement numérique des données et l'analyse des résultats.

### Données et outils de traitement

Les données planimétriques utilisées sont :

- Les images satellitaires de 1990, 2005 et 2018 ;

- Le fond topographique de l'IGN Bénin au 1/200000 de 1992 ;
- Une image SRTM de 2000
- La carte administrative du Bénin au 1/200000
- Les logiciels ENVI 4.7 et Arc GIS 10.1 ont servi à faire les différents traitements d'images et Microsoft EXCEL a permis de réaliser les graphes.

### Traitement et analyse des données



Les trois images satellitaires ont subi divers traitements : après la mosaïque des différentes bandes, il a été effectué dans un premier temps un rehaussement de la qualité des images, c'est-à-dire l'amélioration de leurs contrastes et la composition colorée. Ensuite, elles ont subi des corrections géométriques qui ont consisté à recaler l'image sur un référentiel géographique. La zone d'intérêt a été extraite à partir des limites du secteur d'étude.

- Le reéchantillonnage des images dans ENVI 4.7 vu que les trois images n'ont pas la même résolution spatiale afin de faciliter leurs superpositions ;

- L'interprétation visuelle des images combinées en vue d'identifier les différentes unités d'occupation des terres de la commune et de délimiter les aires d'entraînement pour la classification. Ainsi, en nous basant sur notre connaissance du milieu et la clé d'interprétation des images satellitaires établie par OSFACO, cinq unités d'occupation ont été identifiées. De plus, c'est la nomenclature de Corine Land Cover qui a été utilisée. Il s'agit donc :

- Savanes arborées et arbustives en magenta moins vif et vert clair,

- Mosaïques de champs et jachères sous palmiers en rouge clair blanc et blanchâtre,

- Mosaïques de champs et jachères en blanc et blanchâtre,

- Plantations en rose pure ou rouge sombre suivant le type de plantation,

- Agglomérations et des sols nus en cyan ;

- Le lancement de la classification proprement dite à partir de la méthode de classification supervisée avec l'algorithme « Maximum de vraisemblance » ;

- L'évaluation et la validation de la classification : L'évaluation des résultats d'une classification se fait grâce à la comparaison de l'image classée avec des données de référence (photographies aériennes, cartes, images) ou par confrontation des résultats à la réalité terrain (relevés de terrain). Dans ce cas-ci, la validation a été effectuée sur la base d'un relevé du terrain.

- La vectorisation des images classifiées et leur exportation dans Arc GIS 10.1 ;

- La restitution cartographique qui a permis de réaliser les cartes d'occupation des terres pour les deux dates.

Pour l'analyse des résultats issus de la classification des images, les taux de changement global et les taux moyens annuels d'expansion de chaque unité d'occupation ont été calculés :

- Le taux moyen annuel d'expansion (T) définit la proportion de chaque unité qui a changé au cours d'une année et est évalué suivant la formule utilisée par Oloukoi (2006, p. 311) :

$$T = [(\ln S_2 - \ln S_1) / ((t_2 - t_1) \times \ln e)] \times 100$$

S1 et S2 étant la superficie d'une unité d'occupation à la date t1 et t2 ; t2-t1 étant le nombre d'années d'évolution ; ln est le logarithme népérien et e la base du logarithme népérien avec e = 2,71828.

- Le taux de changement global (Tg) exprime la proportion d'une unité d'occupation qui change au cours d'une période donnée ou entre deux dates.

$$Tg = [(S_2 - S_1) / S_1] \times 100$$

L'analyse des valeurs du taux de changement montre que les valeurs positives indiquent une progression et les valeurs négatives une régression. Les valeurs proches de zéro indiquent que la classe est relativement stable (Kpédénou et al, 2017, p. 213).

Enfin, la matrice de transition obtenue à partir du croisement des deux cartes d'occupation des terres grâce à l'outil « Intersect » de ArcToolbox du logiciel ArcGIS a permis de mettre en évidence les changements observés dans le bassin versant du Lomon. Elle a ainsi permis de calculer les taux de régression, de stabilité et de progression des différentes unités d'occupation des terres.

### 3. Résultats et discussions

Les résultats concernent l'état de l'occupation du sol, l'étude de la dynamique de l'occupation du sol et les facteurs de cette dynamique.

#### 3.1. Etat de l'occupation du sol

##### 3.1.1. Etat de l'occupation du sol en 1990

En 1990, les superficies occupées par les champs et jachères sous palmiers étaient supérieures à celles des autres unités d'occupation du sol. Les différentes proportions sont représentées par la figure 2.

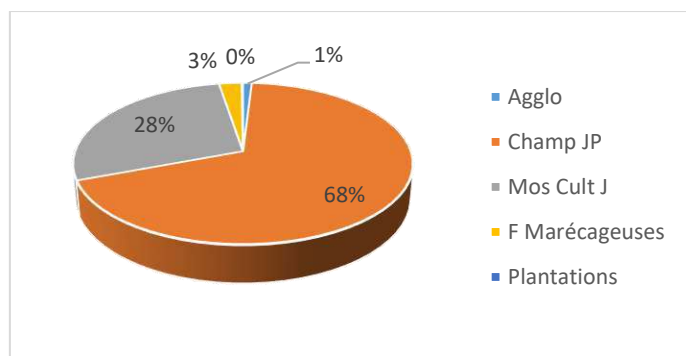


Fig.2 : Superficies des différentes formations végétales identifiées en 1990

Source : Travaux de laboratoire

Les champs et jachères sous palmiers (champs JP) occupaient 22 409 hectares soit 68,32 % de la superficie totale du secteur d'étude. La mosaïque de cultures et de jachères couvrait 9213 hectares soit 28,08 % de la superficie totale. Ces deux formations représentant 96,4 % s'étalaient sur l'ensemble de la superficie totale. Quant à la formation marécageuse, elle s'étendait sur 809 hectares soit 0,46 % de la superficie totale et se localisait dans les arrondissements de Tori-Cada et Avamè. Les

agglomérations dispersées couvraient 316 hectares, soit 0,96 % de la superficie totale. La superficie occupée par les plantations était très réduite et s'élevait à 53 hectares, soit 0,16 % de la surface totale.

### 3.1.2. Etat de l'occupation du sol en 2005

En 2005, les champs et jachères sous palmiers couvraient 11803 hectares, soit 36 % de la superficie totale comme l'indique la figure 3.

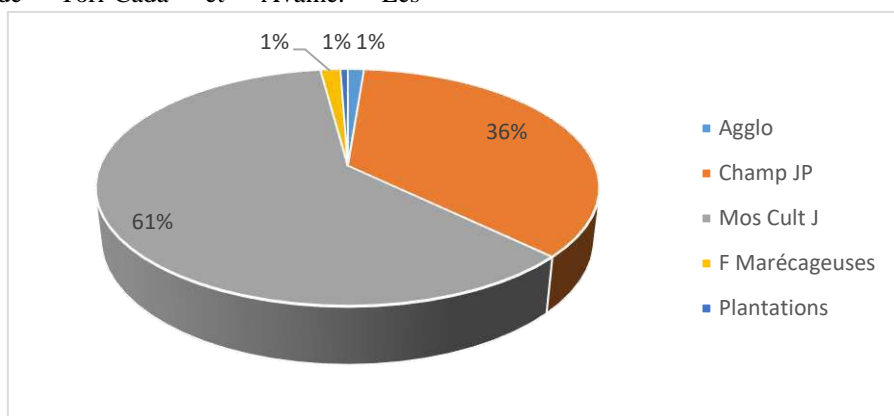


Fig.3: Superficies des différentes formations végétales identifiées en 2005

Source : Travaux de laboratoire

Ces formations sont considérablement réduites au profit des mosaïques de cultures et de jachères qui couvraient 19902 hectares soit 61% de la superficie totale.

Les plantations d'une superficie 185 hectares, soit 1 % du total se localisaient à l'ouest dans les arrondissements d'Azohouè-Cada, Tori-Cada et AzohouèAliho.

Les agglomérations s'élevant à 407 hectares, soit 1 % de la superficie totale, étaient dominantes au Sud de la zone d'étude avec la formation de principaux noyaux dans les arrondissements urbains de Tori-Bossito, Tori-Cada.

### 3.1.3 Etat de l'occupation du sol en 2018

La figure 4 montre les superficies des différentes formations végétales identifiées en 2018.

Il ressort de cette figure 4 que la formation végétale la plus dominante du cadre d'étude est la mosaïque de cultures 27611 hectares (84%). Toutes les autres formations telles que les plantations, les champs et jachères sous palmiers 2026 hectares (6%) occupaient 22 409 hectares soit 68,32% de la superficie totale du secteur d'étude. La mosaïque de cultures et de jachères des champs et jachères sous palmiers étaient supérieures à celles des autres unités d'occupation du sol. Les différentes proportions sont représentées par la figure 2.

### Dynamique de l'occupation du sol de 1990 à 2005

Les différentes formations ont connu d'importantes modifications de 1990 à 2005 (tableau n°1)

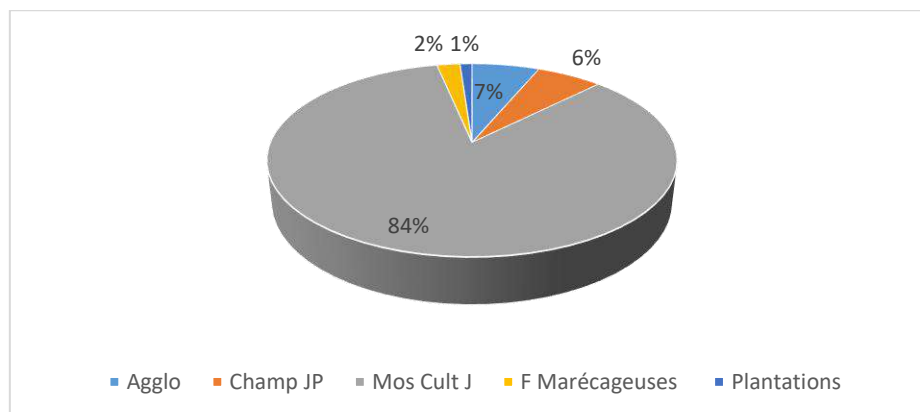


Fig.4 : Superficies des différentes formations végétales identifiées en 2018

Source : Travaux de laboratoire

Tableau n°1 : Variation des superficies de 1990 à 2005

Unités d'occupation du sol	Superficie/ha		Variation (□)	
	1990	2005	ha	%
<b>Agglomération</b>	316	407	+91	+0,27
<b>Champ et jachères sous palmiers</b>	22409	11803	-10608	-32,34
<b>Mosaïque de cultures et jachères</b>	9213	19902	+10689	+32,58
<b>Formation marécageuses</b>	809	503	-306	-0,93
<b>Plantations</b>	53	185	+132	+0,4
<b>Total</b>	32800	32800		

Source : Travaux de laboratoire

Toutes les unités d'occupation des terres ont subi des changements notables entre 1990 et 2005. La plus grande régression a été observée au niveau des champs et jachères sous palmiers. Ils ont connu une régression de 32,34% entre 1990 et 2005. La superficie des formations marécageuses a été réduite de 0,93%. La superficie de ces deux formations a diminué de 33,27%. Par contre, les Mosaïques de cultures et jachères ont connu la plus grande

augmentation de plus de 32,58% de même que les plantations et les agglomérations de 0,27%. Ces modifications observées découlent de l'emprise humaine sur l'espace.

### Dynamique de l'occupation du sol de 2005 à 2018

Entre 2005 à 2018 les formations végétales ont connu une diminution considérable de leur superficie (tableau n°2)

Tableau n°2 : Variation des superficies de 2005 à 2018

Unités d'occupation du sol	Superficie/ha		Variation (□)	
	2005	2018	ha	%
<b>Agglomération</b>	407	2082	1675	05,10
<b>Champ et jachères sous palmiers</b>	11803	2026	-9777	-29,80
<b>Mosaïque de cultures et jachères</b>	19902	27611	7709	23,50

<b>Formation marécageuses</b>	503	711	208	0,63
<b>Plantations</b>	185	370	185	0,56
<b>Total</b>	32800	32800		

Source : Travaux de laboratoire

La superficie des agglomérations a connu de 2005 à 2018 une augmentation de 5,10%. Celle de la mosaïque de cultures et jachères a progressé de 23,50%. Celle des plantations a presque doublé. A l'inverse, les champs et jachères sous palmiers ont connu une régression de plus de 29,80%.

**Dynamique de l'occupation du sol de 1990 à 2018**

Les données actuelles indiquent une accentuation de la dégradation des champs et jachères sous palmiers et de formation marécageuse 1990 à 2018 qui se poursuit (tableau n°3)

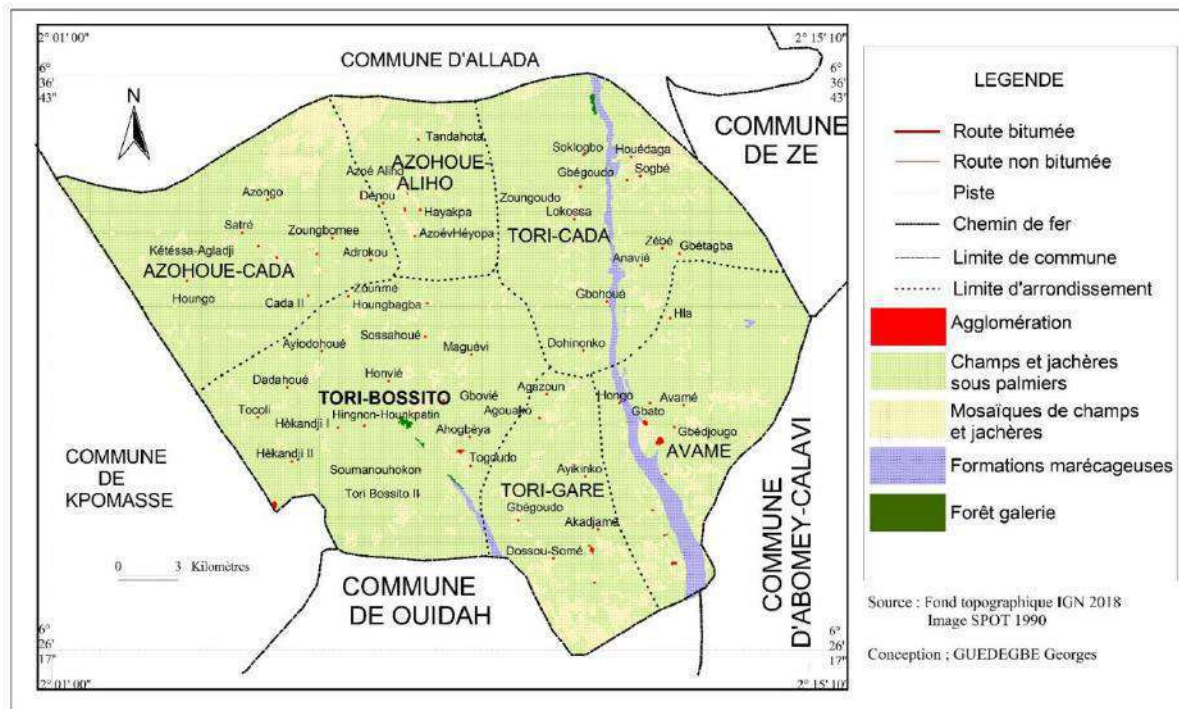
Tableau n°3 : Variation des superficies de 1990 à 2018

Unités d'occupation du sol	Superficie/ha		Variation (□)	
	1990	2018	ha	%
<b>Agglomération</b>	316	2082	1766	5,38
<b>Champ et jachères sous palmiers</b>	22409	2026	-20383	-62,14
<b>Mosaïque de cultures et jachères</b>	9213	27611	+18398	+56,09
<b>Formation marécageuses</b>	809	711	-98	-0,29
<b>Plantations</b>	53	370	317	0,96
<b>Total</b>	32800	32800		

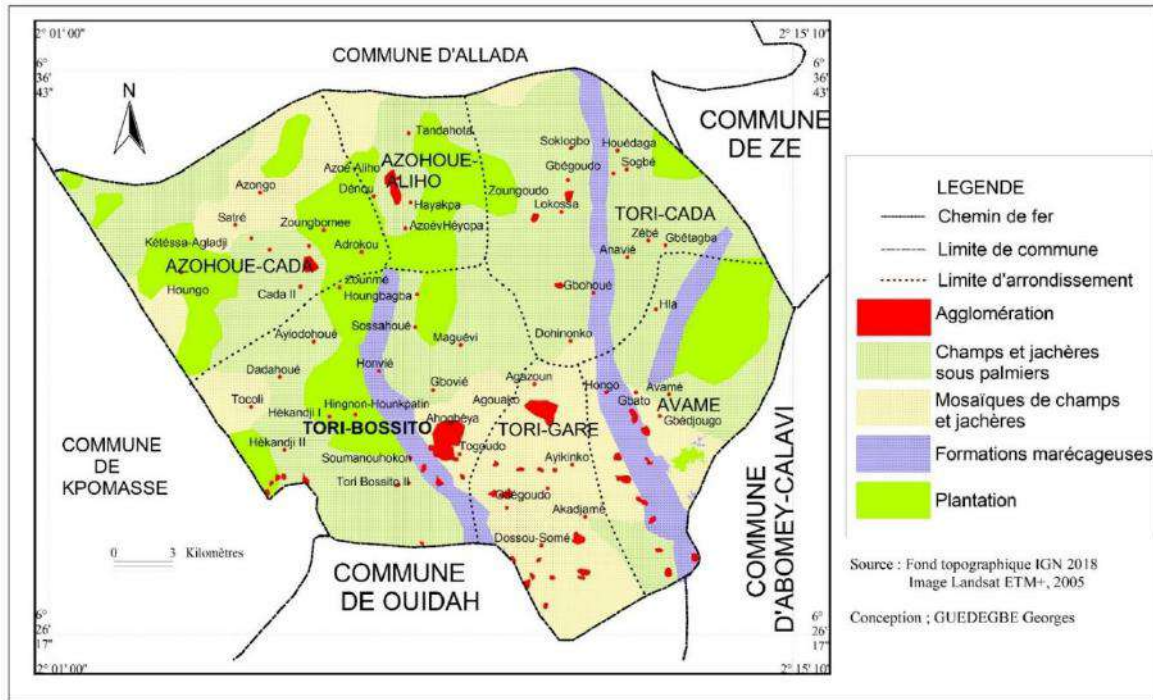
Source : Travaux de laboratoire

Deux ordres de régression ont été enregistrés de 1990 à 2018. Le premier concerne les portions des champs et jachères sous palmiers réduites à plus de 62,14%. Le second a trait aux formations marécageuses (moins de 0,29%). Par contre les agglomérations et les mosaïques de cultures et jachères ont connu respectivement une progression de plus de 5,38% et 56,09%. On peut affirmer que les cultures et jachères, les agglomérations constituent le paysage dominant du milieu.

Carte 1 : Occupation du sol de la Commune de Tori-Bossito en 1990

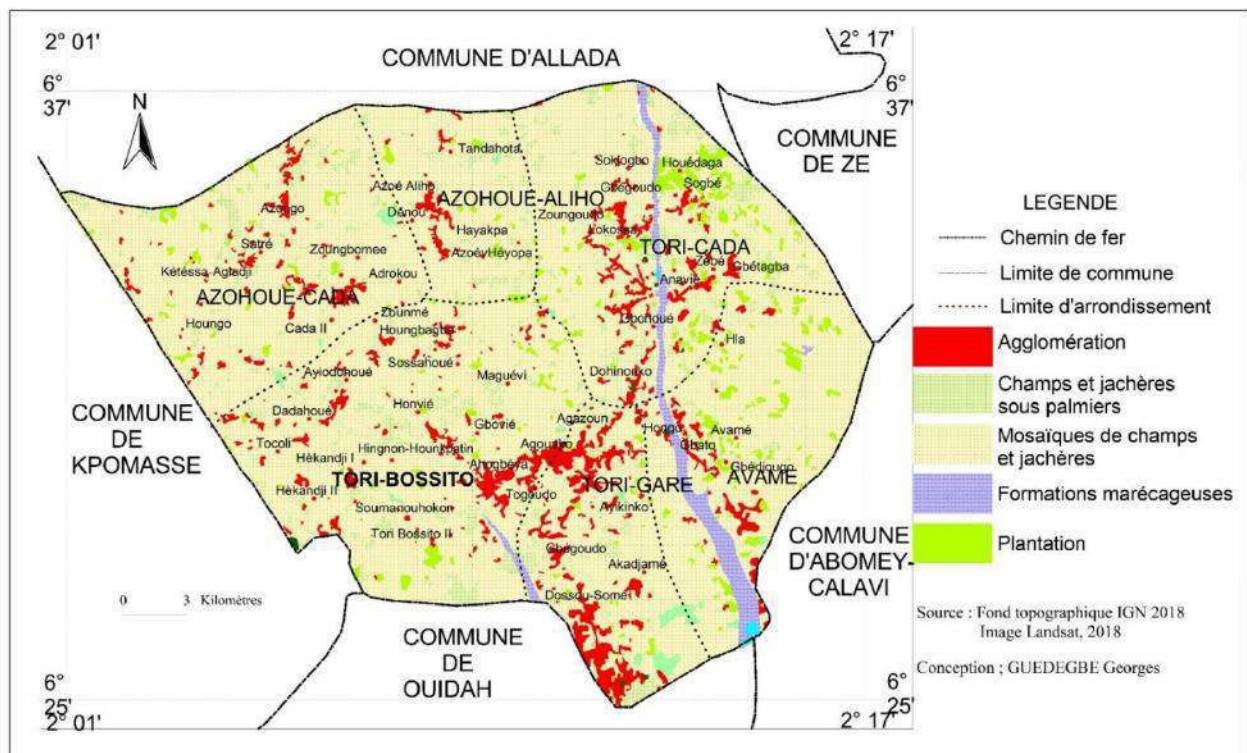


Carte 2 : Occupation du sol de la Commune de Tori-Bossito en 2005



L'examen comparé des cartes 1, 2 et 3 montre que toutes les unités d'occupation du sol ont connu une dynamique (régressive ou progressive selon le cas) de leurs superficies. Les superficies des différentes unités d'occupations du sol dans la Commune de Tori-Bossito entre 1990, 2005 et 2018 ainsi que les proportions de leurs dynamiques sont consignées dans la figure 5.

Carte 3 : Occupation du sol de la Commune de Tori-Bossito en 2018



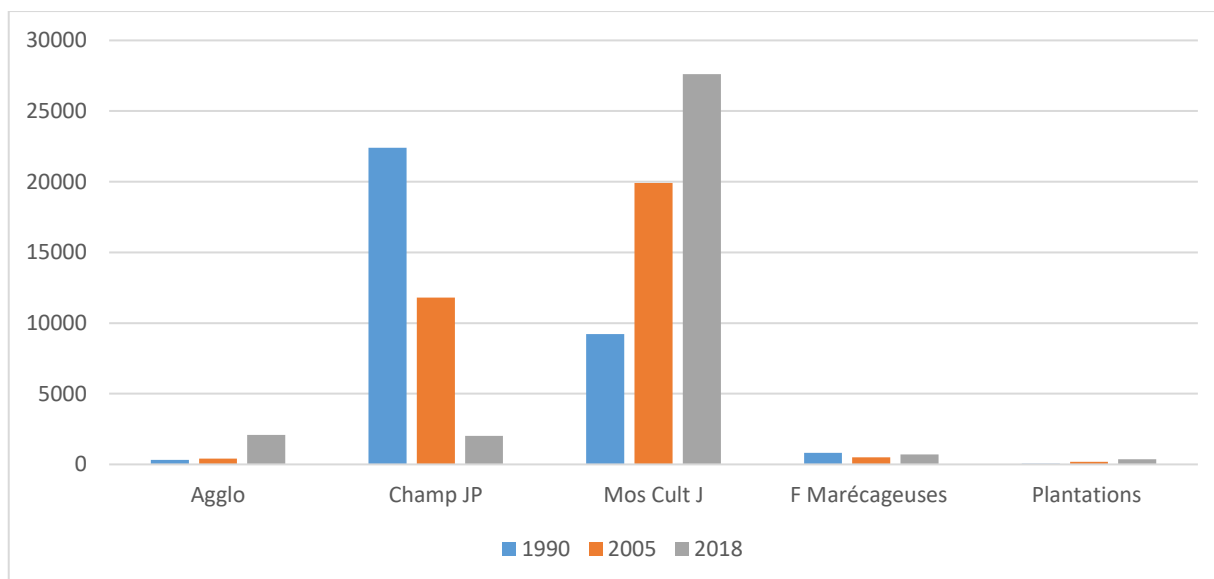


Fig.5: Evolution des unités d'occupation du sol dans la Commune de Tori-Bossito de 1990 à 2018

Source : Traitement Image satellites, 1990, 2005 et 2018

Tableau 4 : Superficies et proportions de la dynamique des différentes unités d'occupation du sol dans la Commune de Tori-Bossito (1990, 2005 et 2018)

Unités d'occupation du sol	Superficie/ha en 1990	Superficie/ha en 2005	Superficie/ha en 2018
Agglomération	316	407	2082
Champs et jachères sous palmiers	22409	11803	2026
Mosaïques de cultures et jachères	9213	19902	27611
Formations marécageuses	809	503	711
Plantations	53	185	370
<b>Total</b>	<b>32800</b>	<b>32800</b>	<b>32800</b>

Source : Traitement Image satellites, 1990, 2005 et 2018

L'analyse du tableau 4 montre qu'en 1990, l'Agglomération (316 ha), les Mosaïques de cultures et jachères (9213 ha) et les Plantations (53 ha) ont considérablement progressé et ont atteint respectivement, en 2018, 2082 ha, 27611 ha et 370 ha. Ces unités ont progressé au détriment des Champs et jachères sous palmiers et les Formations marécageuses qui ont perdu

respectivement une superficie de 20.383 ha et 98 ha entre les deux dates (1990-2018). On peut donc retenir que la tendance régressive est observée au niveau des grandes formations végétales naturelles pendant que la tendance progressive est caractéristique des formations anthropiques (figure 5).

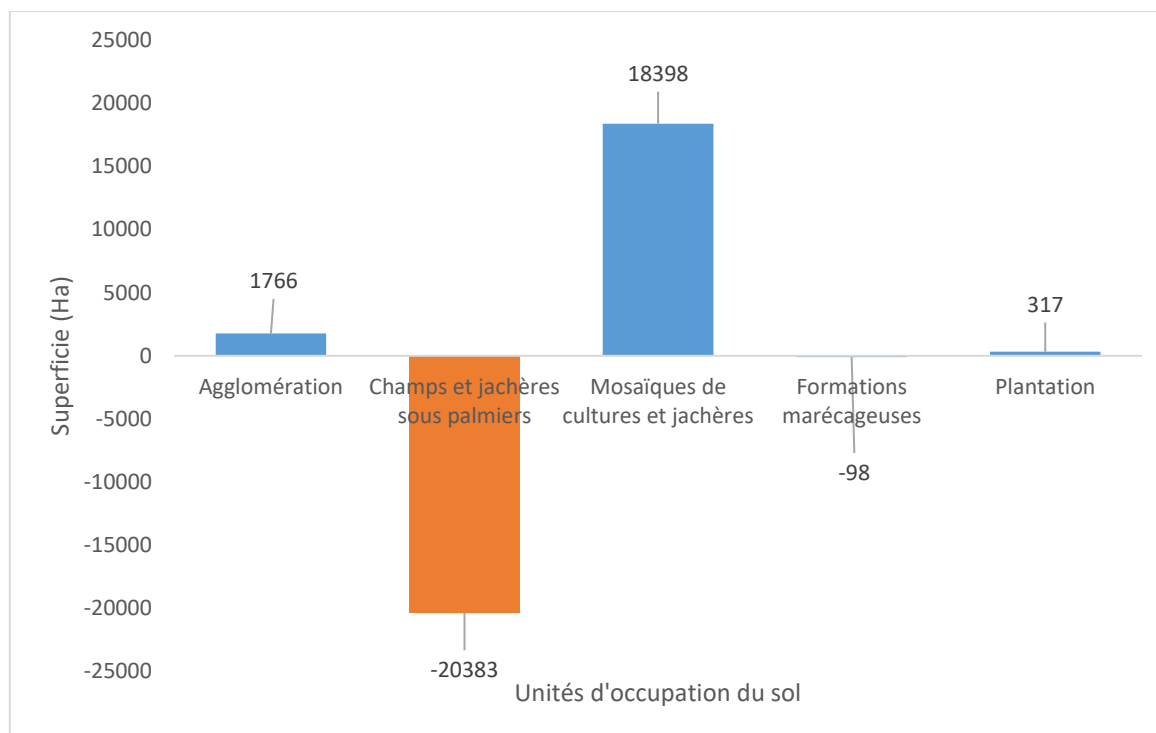


Fig.5 : Evolution des unités d'occupation du sol dans la Commune de Tori-Bossito de 1990 à 2018

Source : Traitement statistique de l'occupation du sol de 1990 à 2018

L'analyse de la figure 5 montre que de 1990 et 2018, les champs et jachères sous palmiers et les formations marécageuses ont régressé de 20383 ha et 98 ha au profit des agglomérations (1737 ha) de la mosaïque de cultures et jachères (18318ha) et des plantations. Ce qui indique que la dégradation des formations végétales naturelles a été faite au profit des formations anthropiques.

Au vu de ce constat, les activités agricoles doivent être menées en occultant les pratiques d'extension de superficies cultivées.

Selon les résultats de l'étude diachronique de l'occupation du sol, la superficie des agglomérations a donc connu une progression. Dans le même temps, les superficies des Champs et jachères sous palmiers et les Formations marécageuses ont connu une régression dans la même période.

### III. DISCUSSION

L'analyse de la dynamique de l'occupation du sol dans la commune de Tori-Bossito fait ressortir différents processus d'évolution du paysage durant la période de 1990 à 2018. On assiste à une dégradation accélérée du paysage qui se traduit d'une part par des régressions et des progressions et d'autre part par des conversions et modifications.

A titre illustratif, deux ordres de régression ont été enregistrés de 1990 à 2018. Les portions des champs et

jachères sous palmiers sont réduites de 62,14% et les formations marécageuses de 0,29%. Par contre les agglomérations et les mosaïques de cultures et jachères ont connu respectivement une extension de 5,38% et 56,09%.

On peut donc retenir que la tendance régressive est observée au niveau des grandes formations végétales naturelles pendant que la tendance progressive est caractéristique des formations anthropiques. La régression de la végétation aux profits des zones anthropisées confirme les résultats d'autres études. Au Bénin, dans les communes de Dassa-Zoumè et de Glazoué, R. Kadjègbin (2014, p211) dans ses études constate que la dynamique de l'occupation du sol est caractérisée par une extension des superficies cultivables. Ces superficies cultivables sont devenues le type d'occupation du sol le plus dominant et les forêts galeries et les forêts denses sont en voie de disparition. Dans les terroirs des 2KP (Kouandé-Kérou-Péhunco) au nord-ouest du Bénin, A. SABI YO BONI (2019, p144) dans l'analyse diachronique de l'occupation du sol (1986-2020) confirme que la forêt maintient sa tendance d'évolution régressive durant toute la période pendant que les agglomérations et les autres formations anthropiques continuent de croître. De même, J.C. Wokou (2014 p154) dans ses travaux sur la dynamique de l'occupation du sol dans le bassin versant du Zou entre 1978 et 2006 aboutit au résultat d'une dégradation des composantes naturelles. Le taux moyen de régression

estimé à + 12,42 % en raison des dynamiques agricoles dominées par la technique de culture sur brûlis développée par les communautés rurales pour s'adapter à l'évolution de la population et du climat dans le bassin versant du Zou. Il projette à l'horizon 2050 que la situation des formations végétales en général sera plus critique avec un taux moyen de régression évalué à -12,98 % en moyenne sous le scénario catastrophique et de -8,45 % pour le scénario écologiquement. Du coup, la dégradation du couvert végétal engendre des changements globaux car la végétation est l'un des éléments importants du système environnemental qui protège la faune et les sols contre toutes formes d'érosion (J. B. Gnanho, 2016, p.12). Ces mutations des unités paysagères pourraient s'expliquer par des faits majeurs qui découlent des travaux agricoles pour satisfaire les demandes sans cesse de la population galopante et aussi pour les travaux d'aménagement (M. Gibigaye et al, 2018, p.164).

#### IV. CONCLUSION

L'étude de la dynamique de l'occupation des sols de la commune de Tori-Bossito entre 1990 et 2018 a mis en exergue l'anthropisation progressive du paysage au détriment des formations végétales qui régressent considérablement. Cette régression est due à plusieurs facteurs dont les plus importants sont la croissance démographique et ses corollaires, notamment l'extension des surfaces cultivées et les travaux d'aménagement. Compte tenu des résultats trouvés, il est important pour les autorités de cette commune de prioriser les problèmes environnementaux dans les dépenses de souveraineté. Ainsi, il faut la définition des zones prioritaires d'intervention pour la restauration des zones dégradées. Il faut également la mise en œuvre d'une politique de gestion des ressources naturelles et la mise en place de politique et outils adéquats pour la sécurisation des terres cultivables. Cela participe du maintien de la vie sur terre pour les générations actuelles et futures.

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# Perceptions of Teachers of Higher Education of Law in Nanuque-MG before the Student Performance Exam Enade

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**Keywords— Bloom's Taxonomy, Enade.  
Educational Process x Enade.**

**Abstract—** *Enade aims to assess the knowledge of graduates in undergraduate courses in Brazil, knowing the importance of this exam, We decided to delve deeper into the matter. Thus, this article will highlight the perceptions of law professors at the Centro Universitário de Caratinga - Campus Nanuque-MG about Enade. The Federal Government has specific actions aimed at guaranteeing the quality of higher education, and over the years there have been an improvement in the ways of evaluating from different angles of teaching, the institution and student learning, so that today we have introduced the National Student Performance Exam (Enade), with this assessment purpose. The Enade evaluation process occurs cyclically, every three years. Recognizing the importance of this assessment for the entire higher education institution (HEI). Aspects related to Bloom's Taxonomy guide the elaboration of the Enade assessment and all assessments of the INEP system. Bloom's original taxonomy provides six categories of the cognitive domain: knowledge, understanding, application, analysis, synthesis and assessment. With the material studied, this article aims to propose actions to improve the training of law graduates, in addition to serving as a guide for several decisions to improve the proposed process.*

## I. INTRODUCTION

Higher education, if a few decades ago in Brazil, favored more socially favored classes, in recent decades it has also become a reality for a larger portion of Brazilian society in the face of the significant increase in the number of public and private educational institutions.

During graduation, the student goes through several stages in the teaching process regarding the training they want to aim for, most of the time the knowledge acquired is verified throughout the course. This is for some students synonymous with terror, shock, and

may sometimes not consider individual psychological issues in response to this method.

Although there are discussions about the act of evaluating, it is necessary to understand that this procedure is used not only in the educational environment. In addition to the space of these institutions, the evaluation processes are used, for example, in selection processes or competitions, aiming at selection for the job.

The general objective is to understand the perceptions of the professors of the Law course of the Centro Universitário de Caratinga - Campus Nanuque- MG

about Enade of professors in relation to Enade and its mandatory nature, describing the perceptions of professors regarding the need for an examination of higher education students in the law course, seeking from the professors of the Law course, according to Bloom's Taxonomy, as such teachers perceive the classification of the Enade questions, in addition to presenting the teachers' position regarding the mandatory application of the exam in question.

To meet the proposed objective, an exploratory methodology was adopted that seeks to understand the knowledge of each teacher based on a questionnaire on the subject. In this way, we can deepen and consolidate pre-existing knowledge.

To build this research, a bibliographic survey of various materials available on the topic was carried out, such as articles, books, websites, magazines and dissertations. The main databases used are indexing platforms such as Google Scholar, Scielo, journals published on the Sucupira Platform with Qualis Capes certification, the Ministry of Education website and regulations on the subject.

After selection, the materials were read and recorded to organize the information and build the theoretical part of the work in order to direct and carry out the investigation, executing and concluding reliably.

## II. DEVELOPMENT

### 2.1 BLOOM TAXONOMY

Bloom's Taxonomy was created by the American and educational psychologist Benjamin Samuel Bloom, who made contributions to the classification of educational objectives and to the Theory of Domain Learning. Ordered by complexity and cumulative hierarchy, as the simplest category is considered a prerequisite for the more complex category (JESUS; RAABE. 2009).

In this new proposed structure, the dimensions of knowledge and cognitive processes help a better definition of the proposed educational objectives, planning, adequate use of strategies and resources. By being able to apply and understand the Revised Bloom Taxonomy, it is possible to classify the levels of abstraction in these questions and interpret the dimensions of knowledge and the cognitive process, a fact that privileges the choice of appropriate strategies for teaching and learning (FERRAZ; BELHOT, 2010).

Aiming to help the process, the taxonomy categories were hierarchically ordered by complexity and abstraction, so that when reaching a category it means having the domain of the previous categories, being able to intertwine. There is also the dimension of knowledge

(which encompasses what to teach) of the dimension of the cognitive process (which encompasses the cognitive activity involved), being able to create a two-dimensional schema, thus verifying the extent and depth and which can be improved.

Aiming at a better use of the teaching-learning moments, there are planning models based on Bloom's Two-Dimensional Taxonomy that can serve as an example for different educational levels FERRAZ AND BELHOT (2010). The process of planning a discipline or a course is not an easy task, especially for professionals without didactic or pedagogical preparation, a reality that many teachers face regularly (SILVA; MARTINS, 2014).

Adequate pedagogical planning is responsible for delimiting the content, based on effective choices and strategies. When this process does not occur, as a consequence, we have a high degree of student evasion or even frustration on the part of the teacher in the face of students who do not reach the desired level of development (cognitive, competence and ability). This planning is essential and must be structured in a coherent way, considering the general and specific objectives, in the choice of content, strategies and assessment instruments that aim to measure what has been learned and direct, in a corrective and formative way, the educational process (SILVA; MARTINS, 2014).

Knowing that the Revised Bloom Taxonomy has significantly collaborated in the learning processes in a hierarchical way, that is, from the simplest to the most complex, being used to structure, organize and plan disciplines, courses or instructional modules, the quality assessment bodies of the education in Brazil has used this knowledge in the most diverse areas. In higher education, Enade values Bloom's Taxonomy, since the preparation of tests follows a hierarchy, divided into easy (25%), medium (25%) and difficult (50%) questions (SILVA; MARTINS, 2014).

### 2.2 ENADE

Enade assesses the knowledge of graduates in undergraduate courses in Brazil, according to the syllabus provided for in the curricular guidelines that support the construction of skills and abilities necessary for general and professional training, in addition to the level of updating in relation to the Brazilian reality and worldwide (BRAZIL, INEP; 2021).

This higher education assessment initiative began in 1993 by the Institutional Assessment Program for Brazilian Universities (Paiub), initially being a voluntary adherence and self-assessment that extended to the entire institution and was completed with external assessment. Later, in 1996, the National Course Examination (ENC),

law 9,131/95, known as Provão, was implemented. This was applied to more than 55 thousand graduates of the administration, civil engineering and law courses, such action was initiated in response to the new directives of the Law of Directives and Bases of Education LAW Nº 9.394, OF DECEMBER 20, 1996 (BRASIL, INEP ; 2021).

In 2001, after redemocratization, the first National Education Plan was launched, providing for vacancies in higher education for at least 30% of the population aged 18 to 24. In order to improve the assessment of higher education, the Special Commission for the Assessment of Higher Education (CEA) was created in 2003, proposing a new methodology to measure learning in undergraduate courses, SINAES (BRASIL, INEP; 2021).

SINAES's conception of evaluation and global and integrative education, building a national system of evaluation of higher education, from a basic and integrative idea that materializes in certain practices articulated with each other, with the purpose of producing effects and achieving coherent and consistent objectives, through an integration between different instruments and moments of application, having as a basis and structuring axis a global conception of evaluation and higher education, that is, articulating between evaluation and regulation, aiming at the institution as a whole (DIAS SOBRINHO ; 2010).

In 2004, SINAES started to consider three aspects: evaluation of institutions, evaluation of courses and evaluation of student performance. In that year, the National Student Performance Examination (Enade) was applied by INEP, with the aim of evaluating the performance of graduates from this test (BRASIL, INEP; 2021).

In order to observe the periodic processes of evaluation of higher education, and also to judge appeals filed by higher education institutions, the Technical Committee for Monitoring the Evaluation (CTAA) was created in 2006. In the following year, 2007, the Concept Enade, the Preliminary Course Concept (CPC) and the General Index of Evaluated Courses of the Institution (IGC), these being the indicators that aim to measure the quality of courses and higher education institutions and to assist in the management of the regulation processes of higher education, the e-MEC was instituted, according to regulations informed by Ordinance No. 40, of December 12, 2007 (BRASIL, INEP; 2021).

### 2.3 THE EDUCATIONAL PROCESS AND ENAD

Twenty-first century students are a challenge to teachers of another generation, as the vast majority of these students are used to digital technology, including: telephones, Internet, cell phones, iPods, among others.

They grew up in a more technological world and with that they improved, making these uses more common in future careers. In this way, the intrinsic difficulties of teaching increase and demand an improvement in the teaching-learning process (GALHARDI; AZEVEDO, 2013).

The challenge of educating goes beyond planning and evaluating learning, there are still questions that need to be answered for a better understanding of the teaching team, among many we can mention: How to measure student learning? How to determine if performance was not caused by easy tests? How to compare performance between classes? It is natural that there are discrepancies between the classifications suggested by different teachers in the same context or test (GALHARDI; AZEVEDO, 2013).

Knowing the teacher's profile is essential for the teaching-learning process of the discipline: ensuring the provision of quality teaching and teaching to their students, as well as the teacher must be able to identify their qualities and deficiencies with regard to the profile of a good teacher always looking for an efficient improvement (SANTANA; DE ARAÚJO, 2011).

In addition to teachers having to follow the change at different levels related to work, they must control other educational demands, translating a new pedagogical process, articulating new educational conditions (SANTANA; DE ARAÚJO, 2011).

Teachers from any teaching area must be constantly improving, participating in training and qualification courses, referring to their disciplines and what involves teaching, aiming to offer their students excellence in learning (Santana; de Araújo, 2011).

New methodologies and differentiated approaches are very important factors that help in teaching and have come to reinify student learning. Active methodologies, aimed at problem-based learning, with a central focus on students and the teacher; application of diagnostic evaluation; validation and recognition of the skills presented; follow-up of studies, final evaluation, are important tools in reducing the dropout rate, and can surpass institutional strategic planning goals.

### III. DATA ANALYSIS

The municipality of Nanuque-MG is located in Vale do Mucuri and its estimated population in 2018 was 40,839 inhabitants, the economic base of the city in which the present work was carried out, concrete in livestock, agriculture, service provision and local commerce. . The Law course at Centro Universitário de Caratinga - Campus de Nanuque, started 03 (three) years ago, with a high

demand and student engagement with the course, mainly because in the not so distant past, most of the students who intended to graduate in law school, needed to move to the city of Teixeira de Freitas/BA, located about 100 km from the city of Nanuque or to the city of Teófilo Otoni/MG.

Although historically the teaching profession is mostly formed by women, this context has been modified

over the years and it was observed in this study that in the investigated Law course 60% of the professors were male and 40% female (figure 1). The age group of these teachers in the highest percentage was between 21 and 40 years (Figure 2).

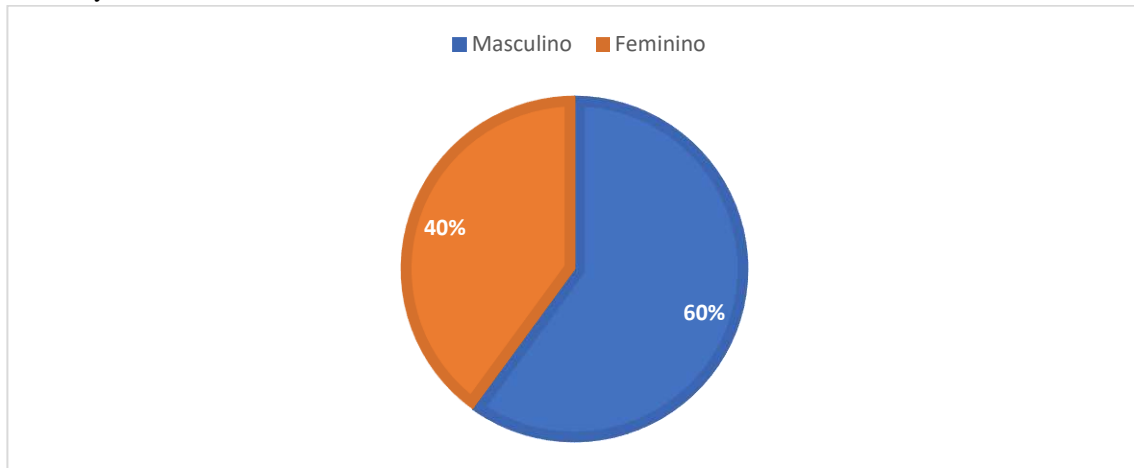


Fig.1: Sex of professors linked to the law course in Nanuque-MG.

Source: Material produced by the author to illustrate the research.

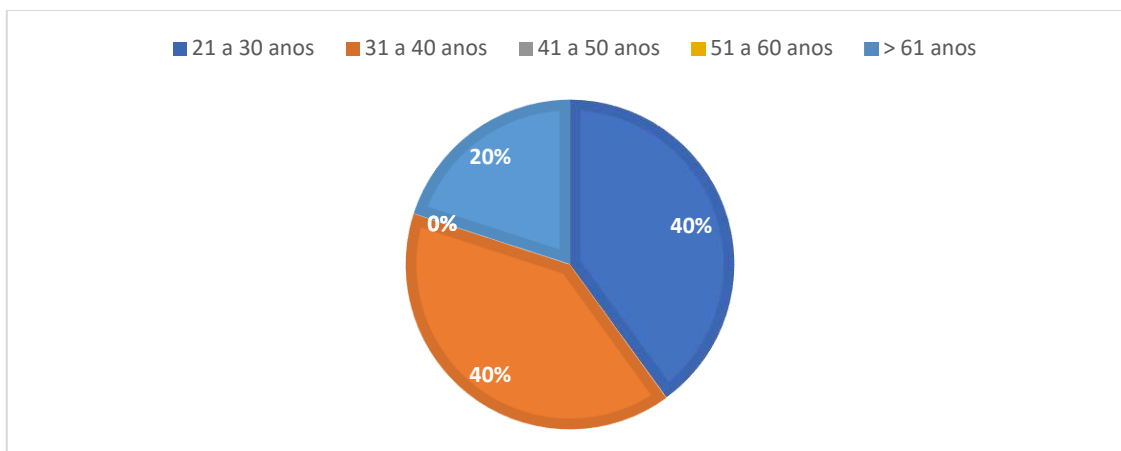


Fig.2: Age group of professors linked to the law course in Nanuque-MG.

Source: Material produced by the author to illustrate the research.

Among these professors, we can observe that 60% have a master's degree and 40% have a specialization/MBA (figure 3). According to the new institutional assessment instruments published in 2017, there is no quantitative requirement for masters and doctors in higher education courses, but we believe that a qualified faculty is essential for students to have good results in their training.

The educational legislation allows newly graduated professionals to make the option of directly entering a Master's Course, not establishing time of experience in the area or the completion of a postgraduate/specialization course. In this way, the level of training is directly linked to professional qualification and the good results obtained for the professional training of teachers (BECERRA, 2010).

Among the professors linked to the IES, only 60% have a contract with a fixed half-yearly workload, a fixed

workload is considered to be a contract that does not vary over the years, regardless of the number of classes, and the other professors are hourly and their The task is simply to

teach classes, with no workload for extension and research (figure 4).

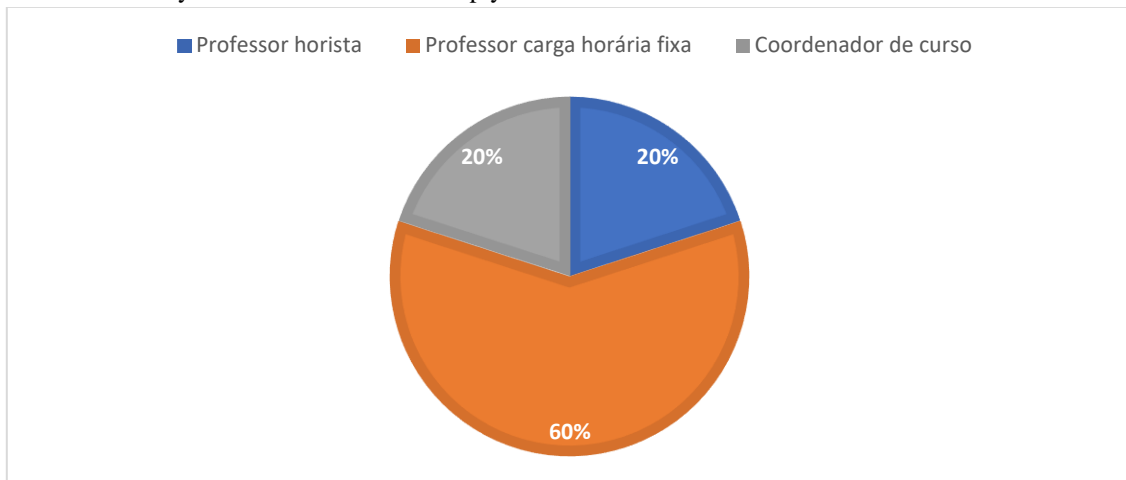


Fig.4: Link of professors linked to the law course in Nanuque-MG.

Source: Material produced by the author to illustrate the research.

After the elaboration of a profile of the group of professors that compose the collegiate of the Law course, the objective was to identify the knowledge of professors about Enade, and according to the professors' reports, the evaluation of Enade in the evaluated institution has not yet taken place, since who did not graduate from the first class.

Although it is necessary to explain that success in the Enade result should not be the final objective of an institution, it is known that the grade of this evaluation incisively infers the possibility of continuing the course. Thus, it is necessary that all teachers involved in the teaching-learning process know the mechanisms.

#### IV. CONSIDERATIONS

When analyzing the perceptions of law professors at Centro Universitário de Caratinga - Campus Nanuque-MG about Enade, it is concluded that there are limitations to understand and apply Bloom's taxonomy throughout graduation.

The general objective of understand the perceptions of law professors at Centro Universitário de Caratinga - Campus Nanuque - MG about Enade was successfully achieved, and the specific objectives of identifying knowledge of professors in relation to Enade and its mandatory nature, as well as professors' perceptions regarding the need for an examination of higher education students, use of Bloom's taxonomy in the course of construction of evaluations and professors' positions on the

mandatory application of the Enade exam in question, were fully achieved.

In analyzing the questionnaires filled in by the teachers, there is a certain contradiction in the answers, especially with regard to knowledge about the evaluation of Enade, making it evident the need for specific training for teachers, with the purpose that the knowledge of the subject is passed on to students.

This is because, it is important to remember that Enade is not developed using only Bloom's taxonomy, and the most important thing is that teachers understand that Enade is built taking into account the learning of an entire course. that throughout the course teachers need to work on issues with different levels of difficulty, explaining the content, taking into account the logic of thought that occurs in the elaboration of the Enade.

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# Determinants of Productivity in Brazil: An empirical analysis of the period 1996-2021

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**Keywords**— *econometric models, private investment, productivity, simulation models.*

**Abstract**—*Empirical studies regarding the determinants of productivity in developing countries, including Brazil, have demonstrated the negative impact of high inflation rates on the industrial capacity. However, the recent Brazilian experience clearly shows that stabilization since 1996, in and of itself, is not capable of recovering the investment rates. With this in mind, this study's goal is to answer, with the help of econometric simulation models, the questions: (i) what are the key-drivers to assess the Brazilian economy since 1996?; and (ii) what are the key-factors to be considered when investments are made, particularly in productivity? To answer the questions we evaluated the impacts of macro-economic variables on private investments, using a strategic bias and a long term vision plan. The estimates demonstrate empirical crowding-in evidence of public investments in infrastructure over private investments as a real impact to productivity. As for public investments (non-infrastructure) we suggest that the crowding-in impact dislocates private investments. All these indicators were obtained as presented in the theory, with the exception of the real interest rates variable ( $r$ ), in which we observed that the coefficient is positive and insignificant in the estimated equation.*

## I. INTRODUCTION

Several studies show the necessity of developing econometric models, using reliable information, to obtain further determinants related to productivity in Brazil, especially since the period related to the implementation of the Real Plan until now. The econometric model is only possible by considering the advances in the theories regarding simulation and the national macro-economic principles. Consequently, we have an interesting combination of information, simulation models and analysis that enable decision-making processes, which can be seen in [6], [7], [10], [12] and [17].

Over the last few years several organizations have been making efforts to apply simulation models in their businesses. Thus, the objective of this article is to

elaborate an econometric simulation model, focused on productivity and with true possibilities of economic growth during the coming years, due to increases in internal consumption, for example. The econometric models presented can be used for macro-economic analysis, as well as for investment decisions, and especially for the analysis of the scenarios hereby presented.

It is noteworthy that the data used refers to the period between 1996-2021, due to the implementation of the Real Plan, and the unfolding of the ongoing international economic crisis of 2007 and Covid-19 nowadays.

According to [19] the econometric model presented does not take into account the variables related to imports and exports, which justifies this methodological option,

due to the fact that any analyses will be directed towards the internal market, with a high percentage of consumption and service sales, thus increasing the economy's need of profound adjustments in order to achieve sustained and long-term growth. We presume that private investment is a function of the GDP growth, however, we will not evaluate the impact of international economies on the Brazilian economy.

However, we will use the real exchange rate as a proxy for the existence of external restrictions, represented by the external debt/GDP rate, to investigate the impact of external conditions on private investments in Brazil.

The performance of the proposed econometric model is the result of the variables utilized, of their restrictions, of the temporal series, and of the long-term estimates of associated risk. However, the suggested evaluations are subject to further studies, which may determine the impact of productivity in the economy. The results achieved by the proposed model are consistent, according to the proposed theory, as well as the results generated with empirical evidence for the decision makers.

This study is divided in five sections: the first is the introduction; Section 2 revising the literature describes the literature related to private investments in Brazil. Section 3 presents the methodology that describes the Cross-Section model, which is proposed to assess the impacts of macro-economic variables on productivity in Brazil. Section 4 presents the results of the econometric simulation for the period 1996-2021 and lastly, section 5 presents our conclusions.

### Revising the literature

The goal of the econometric model in question is to test the hypothesis that the series of private investments, governmental investments, the GDP, interest rates, inflation, among other factors, are correlated, which enables the modelling of long-term behaviour of productivity. Using empirical studies, we will try to

identify if there is an inhibiting factor for private investments derived from the macro-economic instability, from governmental investments and Covid-19 nowadays.

The vital role of capital formation in sustainable economic growth is widely recognized. However, in Brazil and in many other developing countries the investment rates were reduced until the mid 1990's, a fact which was a result mainly of the external debt crises and of lack of inflationary control.

The gross formation of fixed capital in relation to the Brazilian GDP, measured at constant prices, had an average decrease of 23% in the 1970's of 18.5% in the 1980's and of 15.2% in the 1990-1995 period, [4].

In 1998 Brazil's economy felt the impacts of the so-called Asian crises, and in 2008 the great international financial crises happened. Due to the deceleration of the GDP in 2011 it is quite possible that other fiscal measures will be adopted by the government, to stimulate the level of economic activity, especially those related to the increase in credit for 2012 and the years ahead.

The econometric results obtained in other studies related to investments themes, and its determinants in Brazil and in other countries are presented in Table [1]. They summarize the works used as a foundation for the empirical research of this article.

The study of investment behaviour, specifically in the private sector, results from the fact that this is a typically endogenous variable and from the observation that the adoption of specific economic actions in the market will increase the relative importance of productivity in the creation of aggregated capital. Particularly important dimensions of this problem are related to measuring the effects of macro-economic instability on the levels of investments in the private sector, and the identification of the type of relationship that exists between public investment and private investment.

Table 1. Comparison of the macro-economic variables used in Brazil and abroad

Methods and Variables	Luporini and Alves (2010)	Santos and Pires (2007)	Pereira (2005)	Serven (2003)	Schmukler and Serven (2002)	Melo and Rodrigues Júnior (1998)	Rocha and Teixeira (1996)
Sampled country	Brazil	Brazil	Brazil	61 Countries	USA	Brazil	Brazil
OLS	X	-	X	-	-	X	X
Private investment	X	X	X	X	X	X	X
Productivity	-	-	-	-	X	-	-



Tributes	-	X	X	-	-	-	-
Util. of Ind. Cap.	X	-	X	-	X	-	-
Credit	X	-	X	X	X	-	-
Public Investment	X	X	X	X	X	X	X
I <sub>pb</sub> /Y (--)	-	-	-	X	-	-	-
Relative Prices of Capital Goods	-	X	X	-	-	X	X
Inflation (Uncertainty)	X	-	X	X	-	X	-
GDP	X	X	X	-	X	X	X
Cost of Capital (r)	X	-	X	X	-	X	-
Dummies	X	-	-	-	-	-	-
External Debt	X	-	-	-	-	-	-
R <sup>2</sup>	0.92092	-	0.9521	N/D	N/D	0.89	0.85
Log Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	(Except r)		(Except r)	(Except r)		(Except r)	

Source: Authors.

## II. METHODOLOGY

We tried to not only explain the theoretical model underlying the regression analysis, but also to test the existence of stationary and the co-integration between the temporary series we used.

The proposed econometric model combines the use of a series of data related to economic performance - observing organization's behaviors, productive aspects, and growth.

In this model we will present data related to the 1996-2021 period, as this timeframe is relevant for the determination of sector analysis in Brazil, and to indicate in future studies, the insertion of financial products for organizations.

Section "revising the literature" shows the importance of economic assessment. Thus, the present section tries to conduct a bibliographical survey, with the objective of extracting the relevant data to execute the econometric study. The goal of the econometric model in question is to test the hypothesis that the series of private investments, governmental investments, the GDP, interest rates, inflation, among other factors, are correlated, which enables the modeling of long-term behavior of productivity. Using empirical studies, we will try to identify if there is an inhibiting factor for private investments derived from the macro-economic instability and from governmental investments, over the course of the timeframe.

The vital role of capital formation in sustainable economic growth is widely recognized. However, in Brazil and in many other developing countries the investment rates were reduced until the mid 1990's, a fact which was a result mainly of the external debt crises and of lack of inflationary control. The gross formation of fixed capital in relation to the Brazilian GDP, measured at constant prices, had an average decrease of 23% in the 1970's of 18.5% in the 1980's and of 15.2% in the 1990-1995 period, according [4].

The study of investment behavior, specifically in the private sector, results from the fact that this is a typically endogenous variable and from the observation that the adoption of specific economic actions in the market will increase the relative importance of private investments in the creation of aggregated capital. Particularly important dimensions of this problem are related to measuring the effects of macro-economic instability on the levels of investments in the private sector, and the identification of the type of relationship that exists between public investment and private investment.

## III. ECONOMETRIC MODEL

To explain the issue of private investments we chose the following data as part of the functional form: GDP, utilization of industrial capacity, public investments in infrastructure, public investments in non-infrastructure areas, productivity, real interest rates, relative prices of

capital goods, inflation, a credit availability proxy, tax burden, external restrictions, and exchange rates.

The GDP and the utilization of industrial capacity are commonly used factors when specifying equations for level investments, as they reflect the conditions of the demands of the economy and are used to measure the accelerating effect of investment and possible economic cycles. Typically, pro-cyclic economies, such as the ones in developing countries, tend to show a strong correlation between private investments and the variables related to demand.

To measure the impact of public investments on private investments we used public investments in a disaggregated form, separating public investments in infrastructure from the investments in electric energy, telecommunications, and transportation. All other public investments are considered as non-infrastructural. It is crucial to verify if there is empirical evidence of the crowding-in theoretical effect of public investments in infrastructure over Brazil's private investments, and if not, does the expected crowding-out effect occur.

The possible crowding-in effect of public over private investments in infrastructure is theoretically explained by the fact that such investments increase the productivity of capital for future investments and save private investors from additional investments they would otherwise have to make in these areas. As for the crowding-out effects of non-infrastructural public investments, these can be theoretically explained by the competition between them for scarce resources available for investments.

A frequently used variable to explain private investments is the real interest rate, the first theoretic proxy of the cost of capital opportunity. This justifies the choice of this variable as a pre-candidate to compose the final functional form.

The relative price of capital goods is also a key-variable in investment decisions because it directly affects the cost of capital opportunity. It can assess the effects of low competition in the industry of capital goods that result in increasing the prices of these goods above the prices practiced in the rest of the economy, which would negatively impact investments.

Inflation is a commonly used variable as a proxy for uncertainties in the economies of developing countries. This variable was included in the study conducted by Rodrigues Júnior (1998) at Table 1 to assess the impact of Brazil's macro-economic stability over investments.

A proxy variable for the availability of credit in the economy is also commonly used in investment studies, especially in developing countries, in which credit access

is very limited. Obtaining credit or not is, in many projects, a key-element for the impact of credit itself. Thus, the availability of credit should also be considered as a pre-candidate variable. In this article we considered the volume of annual disbursements of the BNDES as a proxy for credit availability in Brazil.

The total tax burden (as a percentage of the GDP) should be used as a possible explanatory variable for private investments. Very few empirical articles use this variable, but in the Brazilian case it may be quite relevant, especially with the significant increase of taxes over the last few years. The motivation for using this variable is because economic agents of the public and private sectors have been complaining about the excessiveness of Brazilian taxes as being one of the major obstacles for private investments.

As for external influences, several indicators were used on the empirical work, such as deviation of products from their long-term trends, the volatility of the stock exchange, the variability of inflation rates and/or of the exchange rates in relation to the debt/GDP, with negative results for private investments, [18]

And finally, [13] uses the relationship between external debt and exports to investigate the effects of external conditions on private investments in Brazil, and in other Latin American countries, confirming the negative results already uncovered in other studies. More recently, [5] investigated the relationship between exchange rates and private investments. The results indicate that the exchange rates affected negatively and significantly private investments over the analyzed timeframe, which was from 1956 to 1996.

Taking Table [1] into consideration, we propose the following generic theoretical model:

$$\text{Priv\_Investments} = f(Y, \text{UCAP}, \text{Pub\_Infra\_Invest}, \text{Non\_Pub\_Infra\_Invest}, \text{Productivity}, r, P\_rel\_bens\_k, \text{IGP-DI}, \text{Emprest\_BNDES}, t, EE, E)$$

In which:

- Priv\_Investments = *strictusensu* gross investment of the private sector (excludes state organizations);
- Y = Real Gross Domestic Product;
- UCAP = average utilization of the industrial capacity;
- Pub\_Infra\_Invest = public investments in infrastructure;
- Non\_Pub\_Infra\_Invest = non-infrastructural public investments;
- Productivity = productivity, as a function of capital, technology and human capital investments;

- $r$  = real interest rate;
- Rel\_Prices\_K = relative prices of capital goods;
- IGP-DI= Inflation
- BNDES\_Dis = Real disbursement of the BNDES;
- T = Tax burden as a percentage of the GDP;
- EE = External restriction, using as a proxy the series Debt Service/GDP (%);
- E = Real exchange rate;
- Dummy = control variable for times of international crises

Based on this expression, we estimate the following econometric equation for the 1996-2011 timeframe, with expresses variables in natural logarithms (except for the real interest rates variable), to directly obtain the elasticity of the variables:

$$LInvest\_priv_t = \beta_0 + \beta_1LY_t + \beta_2LUCAP + \beta_3LPub\_Infra\_Invest + \beta_4LNon\_Pub\_Infra\_Invest + \beta_5LProductivity + \beta_6Lr + \beta_8LReal\_Prices\_K + \beta_9LIGP-DI + \beta_{10}LBNDES\_Dis + \beta_{11}LT + \beta_{12}LEE + \beta_{13}LE + \epsilon_t$$

In which  $\epsilon_t$  is a random disturbance.

In conformity with the model of the investment accelerator, we expect that the increased GDP will generate an increase in productivity, because increased production requires more investments and innovation. The effect of the interest rate is negative and reflects the adverse impact of the cost of capital utilization over investment decisions. Used as a proxy for uncertainty and instability, we expect that the elevation in the inflation rates will decrease investments in the private sector; here the implicit hypothesis is that instability increases the *waiting price* for new information and increases business risks. The relationship between the Private Investment and Public Investment variables is ambiguous because both crowding-in and crowding-out can predominate between the two types of investment.

Table [2] presents a summary of the pre-candidate variables used to explain private and R&D investments in annual series since 1996 and what are the theoretic expected signals.

Table 2 - Pre-candidate variables

Pre-candidate variable	Expected signal
Real GDP	Positive
Average utilization of industrial	Positive

capacity	
Public investments in infrastructure	Positive
Non-infrastructure public investments	Negative
Productivity	Positive
Real interest rates	Negative
Relative prices of capital goods	Negative
Inflation	Negative
Real disbursements of the BNDES	Positive
Tax burden as a percentage of the GDP	Negative
External restrictions	Negative
Real exchange rates	Negative

Source: authors.

#### IV. RESULTS

For the econometric analysis all variables, except for the real interest rates variable, were log-linearized using the natural logarithm, and the remaining series were calculated using the fixed prices of 1995. Because the series used in the estimations of the investment equations are temporal series, we presume that these series are random variables ordered over time. The usual methods of estimation and inference presume that these variables are stationary. The non-stationarity of a stochastic process is due to the existence of a unit root or a stochastic trend in the auto-regressive process (AR), which generates the presence (or absence) of stationarity in the variables used in the estimations.

##### Stationarity tests

Initially the series were subjected to augmented Dickey and Fuller (ADF) unit root tests [2], in level and in first difference. The ADF test is well known and will be described in this section, [3]. It should be remembered that the test statistic is like the t-student test.

The aim of the tests is to show statistical evidence of the integration order of the variables and are, in fact, pre-tests for co-integration, since theoretically only variables with the same integration order can co-integrate.

According to [8], the null hypothesis is that  $\alpha=0$ , in which  $\alpha$  is the coefficient associated to the first lag range of the series, which enters as a regressor AR(p) for the first difference of the hypothesis. The criterion of rejection indicates rejecting  $H_0$  if  $|ADF|>VC$ , in which VC is the critical value of the distribution. As in the case of the existence of a unit root, the asymptotic distribution of t is not the same if the series is stationary (in this case the i of student). Thus, we used critical values tabulated by [9]. The correct choice of lags is important, as they can

influence the performance of the tests. What we did was choose a number which was sufficient to eliminate any possible serial correlation of residues. The choice was made by minimizing information criteria.

The Table [3] below summarizes the results of the stationarity tests. For the timeframe being analyzed the results of the tests favor the hypothesis of a unit root and indicate that the series contains a stochastic trend.

The unit root tests for the selected-on level variables do not reject the possibility of the existence of a unit root in all cases at a 1% level, the only rejection occurred in the LnIGP-DI variable. In other words, there are no statistical evidences that the variables are I(0). The analyses of the results indicates that the series for private investments (Ln Priv\_Investments), GDP (LnY), utilization of industrial capacity (LnUCAP), public investments (LnPub\_Infra\_Invest and Ln Non\_Pub\_Infra\_Invest), Productivity (Ln\_Productivity), real interest rates (r), relative prices of capital goods (Rel\_Prices\_K), loans from the BNDES (LnBNDES\_Dis) and taxation (LnT), may all be considered stationary.

Based on this, one can say that there is statistical evidence that the variables in question can be treated as I(1), and that regressions without their levels (log on level, in the case of the specification used here) are possible and will not present dubious results, as long as the conditions

of co-integration are verified. The theory suggests the possibility of a trend, besides the constant, for the formulations of the unit root tests for the GDP and investments, and that was properly considered.

Considering the other in level significances, we observed that there were rejections for the variables: LY for 5% and 10%, LnUCAP for 10%, LnBNDES\_Dis for 5 and 10%, and LnIGP-DI for 1%, 5% and 10%. A possible explanation for this fact is that the stationarity tests are susceptible to the specification and the measure unit of the variables, which creates difficulties for the analysis of results. Furthermore, the unreliability of the tests makes it difficult to discriminate stochastic series with high dependencies. The real exchange rate (LnE) can be considered stationary with the ADF of -2.6534 with the rejection of the null hypothesis at a 10% level of significance. For the EE variable we have an ADF, in level, of -2.2719 with an integration order I(1).

Given these characteristics, the investment equations were estimated by means of the Ordinary Least Squares methodology. Some of the studies of investment determinants presented in literature use the co-integration technique by means of a system of auto-regressive vectors (VAR). The estimator of Ordinary Least Squares is one of the few estimators whose properties are solidly established in specialized literature.

Table 3. Results of the stationarity tests for the pre-candidate variables on the productivity model using annual data from 1996-2021

Variables	t-ADF	Critical value test 1% significance	Critical value test 5% significance	Critical value test 10% significance	p-value
<b>On level variables</b>					
LnPriv_Invet	- 1,874	- 4,0575	- 3,1199	- 2,7011	0,338
LnY	- 3,431	- 3,9545	- 3,0210	- 2,6801	0,021
LnUCAP	- 2,340	- 3,9501	- 3,0310	- 2,6801	0,175
Ln_Pub_Infra_Inves	- 1,168	- 3,8995	- 3,0701	- 2,6801	0,609
Ln_Non_Pub_Inv_I	- 0,760	- 3,8591	- 3,0011	- 2,6801	0,733
Ln_Productivity	- 1,745	- 4,0470	- 3,01133	- 2,6001	0,231
R	- 1,821	- 3,9101	- 3,0700	- 2,6803	0,321
Ln_Real_Prices_K	- 1,201	- 3,9541	- 3,0001	- 2,6803	0,640
LnIGP-DI	- 5,262	- 4,2000	- 3,1701	- 2,7202	0,001
Ln_BNDES_Dis	- 3,979	- 4,0044	- 3,0914	- 2,6902	0,008
LnT	- 2,061	- 4,0569	- 3,1143	- 2,7004	0,599
<b>First difference variables</b>					
DLnInv_Priv	- 1,800	- 4,0520	- 3,1100	- 2,7011	0,087

DLY	- 3,300	- 3,9503	- 3,0802	- 2,6814	0,004
DLnUCAP	- 2,329	- 3,9503	- 3,0802	- 2,6814	0,035
Ln_Pub_Infra_Inves	- 1,150	- 3,9503	- 3,0802	- 2,6814	0,263
Ln_Non_Pub_Inv_I	- 0,760	- 3,9503	- 3,0802	- 2,6814	0,454
Ln_Productivity	- 1,766	- 4,8300	- 3,0802	- 2,7012	0,059
Dr	- 1,820	- 3,9540	- 3,0802	- 2,6814	0,088
DP_Real_Prices_K	- 1,199	- 3,9540	- 3,0802	- 2,6814	0,249
DLnIGP-DI	- 5,200	- 4,1007	- 3,1001	- 2,7289	0,000
DLnBNDES_Dis	- 3,930	- 4,1007	- 3,0902	- 2,6904	0,001
DLnT	- 2,055	- 4,1007	- 3,1088	- 2,7011	0,069

Source: authors.

For the unit root tests of the selected variables in first difference we observed that the results repeat themselves, as they do not reject the possibility of the existence of a unit root in all the cases at a level of 1%, the only rejection occurred in the DLnIGP-DI variable. In other words, there are no statistical evidences that the variables are I(0).

The main objective of the estimations presented on Table [3] is to test the hypothesis of the crowding-in effect of public investments on infrastructure over private investments.

#### Final functional form for annual data related to 1996-2021

The Table [4] below shows a summary of the pre-candidate variables used to explain productivity in Brazil, in annual series from 1996 onwards, and the expected signals for the relationship between each one of them and private investments.

Contrary to the study performed by [1], this analysis opted for including the variables that presented low significance in the final model. The model presented low significance for the variable that assesses uncertainties (LnIGP-DI), which was also confirmed by the stationarity tests, and for the total tax burden variable (LnT).

Furthermore, our analysis specified a dynamic model, including the lag in the private investment variable (DLnInv\_Priv(-1)), because by using contemporaneous variables the model would present problems with the autocorrelation of residues. The first lag of the private investment variable is commonly used in several studies, since some investments cannot be completed in only one year, which explains the use of this variable to assess the inertia effect on investments.

In the first equation estimated we inserted a control variable for times of political instability, represented by a dummy (D1), which assumes unitary values for the years

of 1997 (Asian Crises), 1998 (Russian Crises), 1999 (Argentinean Crises and the Brazilian Currency Devaluation), 2008 (World Financial Crises) and 2020 (Covid-19).

Overall, the model presented a satisfactory explanatory rate ( $R^2 = 0.95$ ), which is a result coherent with the majority of the studies shown in Table [1]. One can also observe the importance of the irreversibility of the investment, reflected in the coefficient of the first lag of private investment, which was positive and significant, indicating that current investments depend on their past values.

This evidence indicates the existence of lags in the decision-making process and in the implementation of private investments, and suggests that current investments not only reflect partial adjustments of current capital to desired levels, but also tend to happen in an accumulated manner or clustered in time (lumpiness).

The signs found for the estimated coefficients were positive, statistically significant and are in accordance with the economic theory, which indicates income increase (LnY) and increase in economic activity (LnUCAP), encouraging and increasing productivity in the country. In the case of the utilization of industrial capacity (LnUCAP) we observed the extremely pro-cyclic characteristic of the Brazilian economy, with a high and positive coefficient (2.86).

This result is compatible with most of the existing empirical studies concerning the determinants of investments in Brazil and in other developing countries, where the variables used to assess the conditions of demand were also significant and relevant in the estimated models.

The results show empirical evidence of the crowding-in effect on public investments in infrastructure

(Ln\_Pub\_Infra\_Invest) over private investments, a positive sign. This means that a stimulus of 1% in public investments for infrastructure will result in a 0.113% increase in private investments.

As for non-infrastructure public investments (Ln\_Non\_Pub\_Infra\_Invest) the sign obtained is also

correct (negative), which suggests that the impact of the crowding-out effect dislocates private investments. This means that a stimulus of 1% in non-infrastructure public investments will result in a 0.0741% decrease in private investments.

Table 4. Productivity determinants

<b>Ordinary Least Squares - Dependent Variables: Private Investment (1996-2011)</b>			
<b>Explanatory Variables</b>	<b>Coefficients</b>	<b>Expected signal</b>	<b>Obtained signal</b>
Constant	- 9,3500 (-6,0381) [0,0000]	Negative	Negative
DlnProv_Inv(-1)	0,4830 (3,76613) [0,0009]	Positive	Positive
LY	0,499 (1,8263) [0,0697]	Positive	Positive
LnUCAP	2,801 (9,7258) [0,0000]	Positive	Positive
Ln_Pub_Infra_Inves	0,101 (7,3445) [0,0000]	Positive	Positive
Ln_Non_Pub_Inv_I	-0,0703 (-8,0360) [0,0000]	Negative	Negative
Productivity	0,101 (7,3575) [0,00000]	Positive	Positive
R	(7,3433) [0,0000] [0,0527]	Positive/ Negative	Positive
Ln_Real_Prices_K	-1,3581 (-9,8211) 0,0000	Negative	Negative
<b>Explanatory Variables</b>	<b>Coefficients</b>	<b>Expected signal</b>	<b>Obtained signal</b>
LnIGP-DI	-0,0474 (0,0522) [0,0000]	Negative	Negative
Ln_BNDES_Dis	0,1705	Positive	Positive

	(9,791057)		
	[0,0000]		
LnT	- 1.1800 (0,008) [0,0000]	Negative	Negative
LnE	-0.09251 (-2.19204) [0.03720]	Negative	Negative
Dummy 1	-6,45 (-3,0061) [0,9951]	Negative	Negative
R <sup>2</sup>	0.956458		
Adjusted R <sup>2</sup>	0,953631		
DW	2.59		
Log Likelihood	338.5426		
Statistic F	338.2824		
Prob(F)	0,0000		

Source: Elaborated by the authors

Note: t statistics are between parentheses and p-values are between brackets.

However, the theory suggests that after the initial perverse effect of the competition for resources between private and non-infrastructure public investments, it is reasonable to suppose that these investments can also contribute (even if just a little, when compared to the infrastructure investments) to increase the productivity of private capital to be invested in the future (public investments in education, productivity, and each other).

In the case of the real interest rates variable ( $r$ ) we observed that the coefficient is positive and non-significant in the estimated equation. Although the estimated coefficient signal goes against what was theoretically expected, the coefficient is numerically very close to zero (and non-significant), which indicates that this proxy for capital use costs did not contribute to the productivity. This evidence was also found by [7] who also estimated equations using macro-economic data for the 1972-1996 and 1970-2005 timeframes, respectively.

Although capital cost is theoretically important for the determination of the productivity, the difficulty to obtain significant coefficients with negative signs for this variable is widely spread in specialized literature. In the Brazilian case, especially, cost capital coefficients so close to zero can be explained, on one hand, by the organizational tradition of not seeking external financing for the company, and on the other hand, by the volatility of the

interest rates during periods with high inflation, which made interest rates a negligible reference for calculating the opportunity costs of investments.

Literature also indicates that if interest rates rise and if competition for limited resources increases this will result in the dominance of the crowding-out effect over the crowding-in effect. This can be partially explained by the progressive deterioration of the Brazilian's government capacity to invest in infrastructure, because it is the type of public spending that presents the most evident complementarities with private inversions.

Results indicate that an increase in the offer of credit (Ln\_BNDES\_Dis), by means of elevating credit operations aimed at the private sector, will increase private investment in the subsequent years, which confirms the hypothesis that Brazilian organizations face credit restrictions. The results obtained are consistent with the studies performed by [12] and [18], which include financial variables in their empirical studies and indicate that credit availability is one of the relevant variables for private investments in developing countries.

The uncertainties caused by international crisis (assessed by the Dummy 1 "International Crisis" variable) were also relevant in the determination of investments in Brazil, and the negative coefficient obtained indicates that

in times of international economic crisis private investments decrease. Thus, the implementation of responsible and consistent policies over the course of time is crucial to minimize economic uncertainties and to encourage private investments in the country.

We tried to investigate the impact of external conditions on private investments in Brazil, using the External restriction variable (EE), having as a proxy the series Debts of Service/GDP (%). As for external conditions, we suggest that external debts of service did not affect private investments in a significant way during the analyzed timeframe. In fact, the effect of this variable was insignificant in the model and thus, was not included in the final model. One possible explanation for this result is the participation of the public sector in obtaining resources during periods of external crisis, acting as a guarantor for loans contracted by the private sector, and financing investments during periods of external restrictions, and even encouraging the improvement of conditions for external financing.

Finally, the estimated coefficient for exchange rates (LnE) was significant and presented a negative sign, indicating that increased (or devalued) exchange rates do not encourage imports of capital goods, and consequently reduces economic investments. This result is confirmed by [12], who obtained results indicating that the first difference of exchange rates has a significant and negative effect over private investments in Brazil.

## V. CONCLUSION

This article analyzed the major determinants of productivity in Brazil for the period of 1996 to 2021, using data obtained from the Novo Sistema de Contas Nacionais do IBGE (New System of National Accounts of the IBGE), which were recently published by the IPEA. We proposed the elaboration of a model of econometric simulation, focused on productivity connected to the real possibilities of economic growth for the coming years.

The empirical evidence obtained in the models tested confirm the predominance of quantitative variables, such as product and capacity of use, which indicates that increases in income and in economic activity encouraged productivity in Brazil over the course of the studied period. The accelerating effect observed is complemented by the existence of lags in the decision making processes and in the implementation of private investments, which suggests the hypothesis of irreversibility of investment.

The estimation shows evidence that if interest rates are increased and/or if the competition for real limited resources

increases, this will cause the dominance of the crowding-out effect over the crowding-in effect.

The cost of capital utilization, measured by the real interest rates, was not significant, which indicates that the real interest rates do not contribute to reduce productivity, which is a result consistent with the elevated volume of auto-financing by Brazilian organizations. On the other hand, in a wider perspective, the volume of credit for the private sector demonstrated its importance by positively affecting private investment. In this aspect, expanding long term financing lines, adequate for the creation of fixed capital by the organizations, would be extremely important to increase the rate of economic investments.

Besides credit, external factors and exchange devaluations caused, in general, adverse effects on the gross formation of fixed capital in the private sector and on the Brazilian economy during the timeframe analyzed. These results indicate the existence of credit restrictions for Brazilian organizations and also indicate the importance of macro-economic stability and the execution of public policies as an encouraging factor for productivity.

The analysis conducted identified very few articles conducive to econometric studies analyzing sector performance, especially on the productivity and in the insertion of products or services. As a result of these analysis, it is essential that data surveys be conducted to simulate the impacts of macro-economic variables on the productivity, by regions and by sectors in Brazil, adopting the Monte Carlo simulation models, in an attempt to obtain long term estimates. And finally, we hope that this article encourages new studies, with strategic biases and long term vision of innovation, in order to propose innovation strategies.

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# **Bakassi Women in Cross-Border Trade with Nigeria (1963 to 2016): Motivations and Constraints**

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**Keywords—** Bakassi Peninsula, Women,  
Cross-Border Trade, Cameroon, Nigeria.

**Mots clés—** Péninsule de Bakassi, Femmes,  
Commerce transfrontalier, Cameroun,  
Nigéria.

**Abstract—** Bakassi, a peninsula rich in petroleum and natural gas, is Cameroon's, after a lingering border dispute over it with Nigeria which saw Cameroon emerging triumphant. As expected, a large extent of the peninsula's historiography has been pretty conflict-based than otherwise. It is within this basis that the underlying article explores yet an existent but casually exploited field – the experience of cross-border trade in the peninsula. Likewise, Cameroon's reluctant enthusiasm to make gender-equalized evaluations of trade inspired the spotlight of this research on the female gender. It is in this light that the write-up aims at delving into the reasons why the women of Bakassi (in the Cameroon side), ventured into cross-border trade with Nigeria between the years 1963 and 2016 as well as the different constraints witnessed in doing so. Relying on primary and secondary sources while consuming other disciplines where indispensable, the article depended on the thematic, chronological and descriptive models of analysis accordingly. From the objectives and methods adapted, the results of our findings proved that during the years under reflection, historical relationships, intermarriages, differences in natural resource base, differences in prices, devaluation of the Nigerian currency and the economic crisis of the 1980s all motivated Bakassi women to undertake the trade. As for the obstacles faced in the process, they varied from the economic standpoint to socio-cultural restrains. The economic hindrances included corruption, piracy, theft, fraud, price instability, transport and communication network problems and inadequate capital while the socio-cultural obstructions were mainly illiteracy, inadequate access to information and traditional prejudices.

**Résumé—** Bakassi, une péninsule riche en pétrole et en gaz naturel, appartient au Cameroun, après un différend frontalier persistant avec le Nigeria qui a vu le Cameroun sortir triomphant. Comme prévu, une grande partie de l'historiographie de la péninsule a été plutôt basée sur les conflits qu'autrement. C'est dans cette base que l'article sous-jacent explore un domaine encore existant mais nonchalamment exploité – l'expérience du commerce transfrontalier dans la péninsule. De même, l'enthousiasme réticent du Cameroun à procéder à des évaluations du commerce égalisées par genre a inspiré la mise en lumière de cette recherche sur le genre féminin. C'est dans cette optique que l'article vise à approfondir les raisons pour lesquelles les femmes de Bakassi (côté camerounais), se sont

*aventurées dans le commerce transfrontalier avec le Nigeria entre les années 1963 et 2016 ainsi que les différentes contraintes constatées dans Ce faisant. S'appuyant sur des sources primaires et secondaires tout en consommant d'autres disciplines lorsque cela est indispensable, l'article s'est appuyé sur les modèles d'analyse thématique, chronologique et descriptif en conséquence. A partir des objectifs et de méthodes adaptées, les résultats de nos constatations ont prouvé qu'au cours des années sous réflexion, les relations historiques, les mariages mixtes, les différences de base de ressources naturelles, les différences de prix, la dévaluation de la monnaie nigériane et la crise économique des années 1980 ont tous motivé les femmes Bakassi pour entreprendre le commerce. Quant aux obstacles rencontrés dans le processus, ils variaient du point de vue économique aux contraintes socioculturelles. Les obstacles économiques comprenaient la corruption, la piraterie, le vol, la fraude, l'instabilité des prix, les problèmes de réseau de transport et de communication et l'insuffisance des capitaux tandis que les obstacles socioculturels étaient principalement l'analphabétisme, l'accès insuffisant à l'information et les préjugés traditionnels.*

## I. INTRODUCTION

Immediately after reunification, relations between the then Federal Republic of Cameroon and the Federal Republic of Nigeria at the boundary were generally beneficial both to individual citizens and their governments alike. Consequently, trade flow between the two was positive though typified by a significant flow of goods to Nigeria. This was even further concretised thanks to bilateral agreements between both countries. A good example was the one signed on the 6<sup>th</sup> of February 1963. It was a Protocol agreement signed between both countries based on the free circulation of population, goods and services in both countries. Among the many areas of cooperation selected, included were priority economic concerns in financial and custom matters; border exchanges, free movement of persons and goods, cultural and technical matters and judicial and legal assistance.<sup>1</sup> Within the Agreement, several measures were taken to foster bilateral cooperation in the commercial field. Notably, the parties pledged to significantly increase their volumes of trade transactions by all possible means. Most of the later specific agreements between the two countries of Cameroon and Nigeria were derived from this 1963 agreement. Nonetheless, it was the 26<sup>th</sup> February 1963 Protocol, among the many others signed after it that specifically dealt with organizing trade with the aim of facilitating the movement of persons and goods across their boundaries. This Protocol was timely and essential as it was one of the earliest concerns on how to regulate

cross-border movements.<sup>2</sup> In this line, the present article accentuates the relationship between the wants, needs or goals of the women cross-border traders under review and the constraints involved in achieving them. What were the rationale or motivations of the women traders and the general and gender specific constraints? From this problem, it will be interesting to examine the following three aspects: I) Motivations for Bakassi women cross-border traders; II) The Constraints witnessed by Bakassi women during cross-border trade with Nigeria; III) Policy Recommendations.

## II. MOTIVATIONS FOR BAKASSI WOMEN CROSS-BORDER TRADERS

Since independence, trade among countries of Africa has been evolving, with West Africa witnessing an increase especially from the 1990's. This expansion has been credited with profound regional integration, improved economic growth, unemployment reduction, market and product diversification, and improvement in food availability.<sup>3</sup> In this article concerning Cameroon-Nigeria Cross Border trade relationship, the specific motivations for trade between the two while focusing on the women of the Bakassi Peninsula were grouped under Historical/Cultural considerations and Economic factors.

<sup>2</sup> Protocol Agreement covering control of movements of peoples and goods between the Federal Republic of Cameroon and the Federation of Nigeria, February 26, 1963.

<sup>3</sup> Morris G., Saul M., "Women's Business Links; A preliminary assessment of Women Cross-Border Traders", p. 8 in Ndip, Tabi James, "Women in Trans-Border Trade within the Mamfe-Ekok Corridor in South West – Cameroon, (1988 to 2016)", PhD Thesis in History, University of Buea, 2018, p. 5.

<sup>1</sup> Bilateral Cooperation Agreement between the Government of the Federal Republic of Nigeria and the Government of the Republic of Cameroon, February 6, 1963.

### i. Historical and Cultural Relations

Historically, intra-regional trade in West and Central Africa has been characterized by a distinct North-South exchange of goods, where people in the arid and the semi-arid north specialized in livestock production while those in southern tropical lands specialized in agriculture and manufacturing. But both Cameroon and Nigeria share similar climatic conditions, with the northern parts of each country being semi-arid and their southern fronts sharing comparable tropical conditions. Being an East-West trading relationship, other factors determine the trade flows between Cameroon and Nigeria, specifically between women of the Bakassi Peninsula and Nigeria. Ethnic ties or networks, as a function of historical and cultural relations could not be undermined in acting as a driver to cross-border trade in the delimited area. Factually, ethnic networks facilitate trade within and across borders, and these networks play a particularly critical role in states where rule of law is weak and full information and formal third party enforcement of contracts are inadequate.<sup>4</sup> In most rural border localities of Cameroon and Nigeria, the existence of ethnic, historical and cultural relations between people divided between both nations have influenced border enforcement of legal rights to seemingly appear particularly cumbersome, costly, or impossible.<sup>5</sup> The ethnic groups on either sides of the border of both countries compose of both the Bantu and the Semi Bantu.<sup>6</sup> The zone is considered to be the borderland between the Bantu and the Semi-Bantu speaking peoples with the Bantu generally in the Cameroon side and the Semi-Bantu in the Nigerian part.<sup>7</sup> The Bakassi Peninsula and its people make up an extension of old Calabar territory in terms of language, culture and ancestral affinity.<sup>8</sup> The socio-cultural integration of the south west peoples of Cameroon and especially the peoples of Bakassi with the eastern peoples of Nigeria go as far back as the 16<sup>th</sup> Century.<sup>9</sup> The

peninsula is principally inhabited by the Efiks from Cross River State, the Ibibios, Annags, Orons and Andionis from Akwa-Ibom state as well as the Ijaws and Itshekiri from Rivers, Bayelsa and Delta States<sup>10</sup> in Nigeria. These groups perpetually interacted in a system of trade exchange. Thus, socio-cultural affinities were established permitting an attractive pull for the development of cross-border trade in the pre and mostly post independent reunified Cameroon with Nigeria. Even during hostilities at the heart of the Bakassi Crisis (1993-2006), cross-border trading between Cameroon and Nigeria did not stop mainly due to historical and ethno-linguistic ties.<sup>11</sup>

Culturally, intermarriages across the border stimulated the trade. Some women of the Bakassi peninsula border communities were married to the different peoples of South-eastern Nigeria and vice versa. The intermarried claimed dual nationality and they were naturally inclined to criss-crossing the borders to visit their relatives without any disturbances from the border officials of both Cameroon and Nigeria. Sometimes, they bought trade items for sale in their dual border communities and crossed over claiming to visit their homes. Intermarriages were therefore a natural motivation and consequence of cross-border trade within the Bakassi-Nigeria cross-border trade axis.

### ii. Economic Factors

Among the economic factors that acted as a motivating factor for the participation of Bakassi women in cross-border trade with Nigeria since 1963 could be identified differences in the natural resource base in relation to population size and density; differences in prices resulting from divergent trade policies; Devaluation of the Nigerian currency and the Economic crisis in the 1980s.

#### a. Differences in Natural Resources

Bakassi, on the Cameroon side has been blessed with varied food products like *Eru*<sup>12</sup> and *Egusi*,<sup>13</sup> which the cross-border trade women take to Nigerian markets in the densely populated Nigerian eastern region. On the other hand, the vastness of the Nigerian population caused it to have a comparative advantage in the production and distribution of many manufactured goods where economies of scale, access to world markets and

<sup>4</sup> Rauch, James E., 2001, "Business and Social Networks in International Trade", *Journal of Economic Literature*, 39 (4), 1177-1203 in Hoppe, Mombert (& alli), "Estimating Trade Flows, Describing Trade Relationships, and Identifying Barriers to Cross-Border Trade between Cameroon and Nigeria", World Bank Report No: 78283 and ACS2876, May 7, 2013, p. 4.

<sup>5</sup> Hoppe, Mombert (& alli), "Estimating Trade Flows...", p. 5.

<sup>6</sup> Familugba, J.O., & Ojo, O.O., "Nigeria-Cameroon Border Relations: An Analysis of the Conflict and Cooperation (1970-2004)", *International Journal of Humanities and Social Science*, Vol. 3, No 11, June 2013, p. 183.

<sup>7</sup> Ibid.

<sup>8</sup> Familugba, J.O. & Ojo, O.O., "Nigeria – Cameroon Border Relations..." p. 186.

<sup>9</sup> Michael, T. Aletum, "Bakassi Conflict: a Socio-Political Approach", *Juridis Info*, n° 21, May 5, 1994, pp. 42.

<sup>10</sup> Familugba, J.O. & Ojo, O.O., "Nigeria – Cameroon Border Relations..." p. 186.

<sup>11</sup> Konings, P., "The Anglophone Cameroon-Nigeria boundary: Opportunities and conflicts" in *African Affairs*, 104 (415), 2005, pp. 275–301.

<sup>12</sup> Scientifically referred to as *Gnetum Africanum*.

<sup>13</sup> This is a species of seed from melon botanically known as *Citrullus colocynthis*.

agglomeration are important.<sup>14</sup> It is from this outlook that female cross-border traders of Bakassi were motivated in the trade since they were gaining access to Nigerian international markets. While these women mainly crossed with food stuffs to Nigeria, they usually bought manufactured goods like fabric, dresses and cosmetic products from there and back to the peninsula and beyond<sup>15</sup> for resale. This ensured that, the cost in the Nigerian side became relatively cheaper and attractive to Cameroonian traders of Bakassi. Traders often gained access to international markets through their trade relationships with Nigeria

#### **b. Differences in prices resulting from divergent trade policies**

In many ways than not, dissimilarity in trade policies of both Cameroon and Nigeria acted as a rationale for the women of Bakassi to carryout cross-border trade with Nigerian markets nearby. A scenario that highlighted the role of price differences resulting from divergent trade policies in motivating female cross-border traders of Cameroon with Nigeria was the food crisis of 2008.<sup>16</sup> During the crisis, Cameroon responded by eliminating rice import tariffs. The aim was to cushion the impact of escalating food prices and to reduce any potential civil unrest. Prior to the food crisis, Nigeria had a 109 % duty on rice imports. Then in February 2012, a total ban on rice imports was put in place.<sup>17</sup> Such rice policy differences did encourage Cameroonian traders with Bakassi women inclusive to take advantage of higher prices on the Nigeria side of the border. Because trade policies are only partially enforced at borders, these price differences offered significant scope for trade. Consequently, it is evident that recent policies with regard to rice imports in Cameroon and Nigeria have led to substantial rice re-exports from Cameroon to Nigeria with border communities like Bakassi benefitting from the advantage.<sup>18</sup>

<sup>14</sup> Hoppe, Mombert (& alli), "Estimating Trade Flows...", p. 8.

<sup>15</sup> An interview conducted with Magdalene Ebong at Isangele on the 11<sup>th</sup> of April 2020 revealed that after having bought African fabric from Nigeria, she sometimes went to resale as far as in Kumba in the Meme Division of Cameroon. In doing so, she made encouraging profit.

<sup>16</sup> Hoppe, Mombert (& alli), "Estimating Trade Flows...", p. 13.

<sup>17</sup> Ibid.

<sup>18</sup> Consult World Trade Organisation (2007), Trade Policy Review Cameroon, Geneva, Switzerland; and World Trade Organisation (2011), Trade Policy Review Nigeria, Geneva, Switzerland for an overview of trade policies in both Cameroon and Nigeria. An outline of these could however be gotten from Source: Hoppe, Mombert (& alli), "Estimating Trade Flows, Describing Trade Relationships, and Identifying Barriers to Cross-Border Trade between Cameroon and Nigeria",

#### **c. Devaluation of the Nigerian Currency**

Still in the economic domain was the devaluation of the Nigerian currency acting as a driving force encouraging Bakassi natives and other Cameroonian communities alike to pursue cross-border trade deals with Nigeria. According to Investopedia, devaluation is the deliberate downward adjustment of the value of a country's money relative to another currency, group of currencies or currency standard.<sup>19</sup> The devaluation of the Nigerian Naira in the 1980s made Nigerian produced goods cheaper for Cameroonians, while the same goods were expensive for Nigerians. This was so because; the Francs CFA was exchanged for much Naira. Using the much acquired Naira, buyers from Cameroon with focus on Bakassi women, purchased more quantity of goods at a cheaper rate. For example, before devaluation, 1000FCFA was exchanged for 2 Naira 50 kobo in the early 1980s but as a result of devaluation, 1000FCFA was exchanged for 140 Naira in the 1990s. As it continued to fluctuate, it rose to 600, 700 and 805 Naira for 1000FCFA in the black market.<sup>20</sup> This attracted many Bakassi women traders who speculated better profits for the cheap goods bought from Nigeria. To married women, cross-border trade was a means to support their husbands financially for the survival of the family. This was the case with women whose husbands lost their jobs or suffered hardship brought directly or indirectly by the SAP (Structural Adjustment Programme) policies that caused the retrenchment of many workers during the economic crisis. To other married women, they argued that, cross-border trade with Nigeria was among the surest way to make money during those times to sustain their families.

#### **d. The Economic Crisis**

The Economic Crisis of the mid 1980s was another rationale for Bakassi women's participation in cross-border trade with Nigeria. Natan Jua asserted that only a holistic picture could explain the genesis of Cameroon's economic crisis,<sup>21</sup> which will be attempted herein. Although the post-independent economy before 1986 experienced some relative growth and progress, it seems the economy was growing without development as it suddenly plunged into economic crisis in 1986.<sup>22</sup> The

World Bank Report No: 78283 and ACS2876, May 7, 2013, p. 11-12.

<sup>19</sup> [www.investopedia.com](http://www.investopedia.com). Consulted on the 31st of January 2022 at 04:30 AM.

<sup>20</sup> Ndip, Tabi. J., "Women in Trans-Border Trade...", pp. 144-145.

<sup>21</sup> Nantang Jua, "Cameroon: Jump-Starting an Economic Crisis" in *Africa Insight* 21 (1), 1991, p. 162-170.

<sup>22</sup> Ndip, Tabi James, "Women and the Economic Crisis in Many Division of Cameroon, 1986-2010", *Memoire in History*, University of Buea, 2014, p. 72.

roots of the crisis have been traced from some internal and external factors. The internal factors stemmed from the narrow based and dependent economy, unbalanced development and corruption while the external factors are ascribed to the worsening external environment such as the influence of neo-colonialism and a fall in the prices and demand for cash crops in the World Market.<sup>23</sup> The economic crisis may have had a common derivation throughout Africa but the effects varied across countries, regions, sectors, households and among women, depending on the economic, demographic and social circumstances.<sup>24</sup> It was however more imperative on the women probably because Cameroonian and other African men acted entirely as producers meanwhile women got involved in productive activities plus home management, child bearing and upbringing, as well as catering for the aged persons of their families. In this light, the economic crisis and the Structural Adjustment Programme led to an increase in the number of women involved in cross-border trade within the Bakassi-Nigeria margin in the late 1980s. This was so since the number of persons seeking for survival in informal activities amplified.

### III. THE CONSTRAINTS WITNESSED BY BAKASSI WOMEN CROSS-BORDER TRADERS

The widely acclaimed Rational Choice Theory opines that individuals act with specific constraints that are based on the information they have and the conditions under which they are acting. It emphasizes the relationship between the wants, needs or goals and the constraints involved in achieving them.<sup>25</sup> The Probability Theory of Hackling<sup>26</sup> which points to the prevalence of risk and uncertainty in ventures holds true in this case because the issues of risk and uncertainty are indeed similar to the exigencies faced by the women-cross border traders under study. They encountered numerous constrictions that acted as obstacles to their trade adventures as discussed in the proceeding themes and paragraphs.

#### i. Economic Constrictions

Economic obstacles like corruption, piracy, theft, fraud, price instability, transport and communication

network problems and inadequate capital and credit were not uncommon as distinguished in the ensuing clauses

#### a. Corruption

The phenomenon of cross-border trade in the African continent is characteristic of corruption, specifically in the form of bribery. Bribery, according to the English Dictionary<sup>27</sup> is the making of illegal payment to persons in official positions as a means of influencing their decisions. The habitual occurrence of bribery in intra-African trade relations has been a realistic canker worm. Women traders along the Rwanda-Burundi Borders were a glaring case, given the fact that their goods passed along unofficial border routes.<sup>28</sup> In the Bakassi peninsula, bribery was not uncommon. Another but related economic restraint in the business was licensing and Document Procedures. The licensing system aimed at ensuring a sustainable exploitation of many products like *eru*<sup>29</sup>, fish and firewood gave local communities the right to exploit these for home consumption. To trade, however, small traders who constituted mostly women, needed to obtain licenses from government, which they were generally unable to acquire. This pushed many traders of the peninsula into informal trade relationships.

#### b. Piracy and Theft

Besides, piracy and theft added to the hardships of Bakassi women involved in cross-border trade with Nigeria. Dependent on water-way transportation to carryout cross-border trade with Nigeria, some Bakassi women cross-border traders have witnessed the unfortunate situation of having been robbed by pirates. Monica Ano Moki, an owner of a provision store in Isangele greatly made possible through cross-border trade with Nigeria, was a victim. Interview sessions with her revealed that, in returning from the Ikang market in Nigeria to Isangele, pirates attacked their boat full of goods including whisky and bags of rice.<sup>30</sup> In worse circumstances, these pirates not only looted goods and money, but also perpetuated cases of kidnap for high ransom demands.<sup>31</sup> Oral evidence bore allusion to the prevalence of theft by loaders in the process of loading and off-loading of their goods. This situation was not uncommon in other parts of the national territory. At the Bamenda, Santa, Mamfe and Kumba markets for example,

<sup>23</sup> Ndip, Tabi. J., "Women in Trans-Border Trade...", p. 141.

<sup>24</sup> Ndip, Tabi James, "Women and the Economic Crisis...", p. 72.

<sup>25</sup> Green, S.L., "Rational Choice Theory: An Overview", A Paper prepared for the Baylor University Development Seminar on Rational Choice Theory, 2002, p. 73.

<sup>26</sup> Hackling, I., *The Emergence Probability*, Cambridge, Cambridge University Press, 1975.

<sup>27</sup> Livio, "English Dictionary - Offline", version 6.1, released on March 21 2012, in Google Play Store Application.

<sup>28</sup> Ndip, Tabi. J., "Women in Trans-Border Trade...", p. 5.

<sup>29</sup> Ndip, Tabi James, "Ndip, Tabi. J., "Women in Trans-Border Trade...", p. 148.

<sup>30</sup> Interview with Monica Ano Moki at Isangele, 11/04/2020.

<sup>31</sup> Idem.

there were loaders who stole certain goods either to resell or keep.<sup>32</sup> Stolen items were usually not discovered until the trader concerned reached the final destination for resale. Such losses were hurtful and had a negative ramification on the profit margin of the concerned women.

### c. Fraud

Aside from piracy and theft, fraud was not uncommonly witnessed by Bakassi women who partook in cross-border trading in Nigerian markets. Fraud – an act of deception carried out for the purpose of unfair, unlawful or undeserved gain was commonly known as Four-One-Nine (4.1.9.). It was a Nigerian confidence trick which existed before the era of former President Ibrahim Babangida and became pervasive during his tenure of office.<sup>33</sup> If one carried out a fraudulent act and got away with it in the cause of a business transaction thereby making undeserved profit, such a person was said to have made money out of ‘four-one-nine’. If caught, it was believed that the person had already made money out of the act thus had to ‘settle’ the law enforcement officers who got part of their share of profits. Many Bakassi women cross-border traders have fallen victim of these perpetrators of 4.1.9. This was either in the course of currency exchanges through black marketing or while purchasing certain goods from Nigerian traders whereby fake items were given in the place of genuine ones at same price. Women were more vulnerable than most men for certain reasons. Unlike men, most women could not concentrate only on specific trade items when they went to make purchases. They spent more time in the market buying other items not just for business but also for household use. In the course of buying, they got exhausted to the point that, they could easily be cheated or given fake items without realizing it. At other times, these women were in rush to get to the boat at specific hours of the day to get them back to the peninsula.<sup>34</sup>

### d. Price Instability

Instability in prices of goods bought and sold in Nigerian markets was another major obstacle to cross-border trade witnessed by Bakassi women. Sometimes in the Ikang market for example, there was excess supply of products like *eru* from other little Nigerian fishing port communities like Natonda to be sold in the same Ikang

market, main market of the Bakassi communities of Kombo Abedimo and Isangele. In such unfavourable scenarios, and given the fact that *eru* is a perishable product, Bakassi women of Cameroon were forced to reduce the prices per bundle as dictated by the forces of demand and supply. This price reduction brought price fluctuation of goods supplied to Nigerian markets and price instability. The resultant effect was reduction in profit margin and even registered losses. Such a scenario was usually discouraging to the petit and new traders who risked losing business capital. Such losses bringing instability could be attributed partly to lack of marketing information among the suppliers and buyers. Another scenario witnessed by these women leading to price instability had its roots from fluctuations in the currency exchange rate. Women cross-border traders in the Bakassi-Nigeria axis were familiar with the exchange of currency through black marketing. This nonetheless posed a problem because once the exchange rate dropped, cross-border traders from Cameroon exchanged Francs CFA for less Naira, which is the main medium of exchange in Nigeria. Hence the quantity of goods bought by these women was bound to drop. Moreover in certain years, currency fluctuations occurred after few hours only and on a daily bases. For example in the early 1980s, 1000Francs CFA could be exchanged for 2 Naira 50 Kobo. But in the 1990s, it changed to 140 Naira for same amount. The 21<sup>st</sup> Century has witnessed the exchange rate fluctuating between 650 Naira and 805 Naira for every 1000FCFA.<sup>35</sup> Noteworthy is the fact that, these currencies rose and fell with the changes in the United States Dollars in the international market. But a slight change in the Dollars resulted to more fluctuations in the Naira which further affected rates of exchange with the Francs CFA.

### e. Transport and communication network problems

To add, transport and communication network problems could not go unmentioned. According to Patrick,<sup>36</sup> the term “failed state” is often used to describe a state perceived as having fall short at some basic conditions and responsibilities of a sovereign government. Anyanwu<sup>37</sup> states that by a failed state we mean a state that is unable to meet the needs and aspirations of its masses.

<sup>32</sup> Ndip, Tabi, James, “Women in Trans-Border Trade...”, p. 156.

<sup>33</sup> Ibid, pp. 156-157.

<sup>34</sup> This scenario was witnessed by author during a 2020 field work experience. Having left Kombo Abedimo in Bakassi, Cameroon on a boat to Ikang market on the 10<sup>th</sup> of April 2020, it was a realistic observation of both men and women traders hurrying to catch up with boats who left at specific times back to the peninsula.

<sup>35</sup> Ndip, Tabi, J., “Women in Trans-Border Trade...”, pp. 172-173.

<sup>36</sup> Patrick, S., “Failed States and Global Security: Empirical Questions and Policy Dilemmas”, *International Studies Review*, 2007, pp. 644-662, 9 (1) in Okeke, O. Sunday and Oji, O. Richard, “Cross Border Crimes...”, p. 50.

<sup>37</sup> Anyanwu, U., “Failed States in Africa: The Nigerian Case since 1960” *American Journal of International Politics and Development Studies (AJIPDS)* 1 (1), 2005 in Okeke, O. Sunday and Oji, O. Richard, “Cross Border Crimes...”, p. 50.

Consequently, a failed state as opposed to a capable state is a state which has not succeeded to provide for its citizens such basics essentials like adequate security, food, water, electricity, health care, good roads, and what not. Correspondingly, it was therefore no bombshell when respondents in the peninsula clamoured many of these necessities as lacking. Relationally, this scenario complements exponents of the Relative Autonomy Theory, specifically low Relative Autonomy (that is the State becoming the paramount path for primordial accumulation of capital made possible by the embezzlement of public fund).<sup>38</sup>

#### f. Inadequate capital and credit

The difficulties around Inadequate Capital and Credit were equally felt. Capital was among the key factors that affected the participation of women in cross-border trade because cross-border trading activities usually required substantial financial resources for profits to be reasonable. Both female and male traders often relied on personal savings and loans backed by interest as their main sources of capital accumulation. Inadequate finance served as a major impediment primarily to women cross-border trade because it was correlated with limited access to credit facilities. Women had limited ability to reinvest because they extended financial support to their immediate and nuclear families. The dilemma of inadequate capital was the cry and reality of many Bakassi women cross-border traders including Rose Bassey and Glory Etim.<sup>39</sup> In other cases, the loss of capital came as a result of the fact that, family members consumed goods of provision stores and table markets largely made possible through purchase from Nigerian markets.<sup>40</sup> With very minimal collateral, it made it worse for these women to receive credits and loans from financial institutions of any kind.

#### ii. Socio-Cultural Restraints

African societies have had an underlying dependence on women in managing household duties. Challenges incorporating the time consuming trade procedures and documentary requirements encroached more on women, giving the time needed for these household duties.<sup>41</sup> High illiteracy rate/inadequate access

to information; traditional prejudices/male dominance were highlighted as major socio-cultural impediments.

#### a. Illiteracy

To begin, high illiteracy rate was a primordial constrain. Women cross-border traders in Bakassi were not able to fully explore or invest in functional education in which the pursuit of scientific and technological skills crucial for women to develop their capabilities was paramount. The women were lagging behind in crucial contemporary fields like Agronomy, computer literacy, human resource management, Management Science, to name but these few. Hence it was impossible for them to apply modern scientific methods in the cultivation of food and agricultural products that would have increased yields and trading items as well as conservation of perishables. Equally, many of these women lacked the skills or initiatives to make use of the internet in advertising their products or getting access to trading information and border rules. The buying, advertising, selling and paying of charges through the mobile phone and internet was predominantly unknown to most of these women. This could have reduced the stress and delays sometimes characterized by the cross-border trade with neighbouring markets in Nigeria.

#### b. Inadequate access to information

Indisputably, information is a very relevant aspect in cross-border trade. Most of the hardships faced by these women cross-border traders in Bakassi stemmed from lack of information about trading rules and regulations as well as available trading opportunities. Men and women traders were either not aware or not well informed of the details. This was compounded by the fact that trading procedures at the Bakassi-Nigeria Axis were not usually transparent and specific documentations were not always available as well. These circumstances adversely affected the profit margins of the traders.

#### c. Traditional prejudices

The role of culture in restricting women's access to, and control over productive resources in Anglophone Cameroon in general, subjugated them, thus operated as a major restraint to these women's socio-economic empowerment.<sup>42</sup> Opposition from male partners, traditional prejudices and male dominance revealed the restriction. Information from both married and divorced women traders alike indicated that some male partners did not accept their wives to search for money by getting

<sup>38</sup> See Okeke, O. Sunday and Oji, O. Richard, "Cross Border Crimes...", p. 50.

<sup>39</sup> Interview with Rose Bassey, a.k.a. "Ma Quatre Cent" at Kombo Abedimo, 06/04/2020 and Glory Etim at Isangele, 11/04/2020.

<sup>40</sup> Interview with Mama Glory Etim at Isangele, 11/04/2020.

<sup>41</sup> Marcelo M. Giugale in Paul Brenton, Elisa Gamberoni and Catherine Sear (eds) *Women in Trade in Africa; Realising the Potential*, New York, World Bank, 1981, p. 5.

<sup>42</sup> Oben Dorothy, Atanga Lilian & Fondo Sikod "Culture Dynamics in Men's Perception of Women in Anglophone Cameroon", *International Journal of Innovative Research and Development*, 5, n° 8, 2016, pp. 36-44. in Ndip, Tabi J., "Women in Trans-Border Trade...", p.166.



involved in cross-border trade transactions. Some men complained of the abandonment of household duties in favour of the trade along the Cameroon-Nigeria borders.<sup>43</sup> The women cross-border traders were sometimes even labelled as prostitutes, probably because of the presence of retired prostitutes and the pervasive and subtle harassments from border officials that some of the women noted. Field work interview sessions with one of the ladies of Akwa 1, Kombo Abedimo revealed that, she was sometimes reprimanded from partaking in cross-border trade by the husband.<sup>44</sup> His reasons varied from the wife abandoning child raising duties to not wanting to allow the wife mingle and be influenced by prostitutes of the trade. This situation was not much different in other near border localities of the country. At the Mamfe town market for example, it was observed that some of the Ikom-line women in the Mamfe-Ekok trade corridor, contrary to former expectations and belief, were married. This development was explained by the fact that retrenchment, retirement and economic hardship left some married men with no option than to accept any form of income generating activities carried out by their wives. One of the Ikom-line women even had this to say:

...my husband never wanted me to do any form of trade that makes me stay out of my home for long hours. Unfortunately, he lost his job in 1993. We managed like that for four years and by 1997, when things became very hard, a friend introduced me to the Ikom-line business. I raised my capital from the sales of Bush Mango bought from the Ejagham villages of Ewelle, Kembong, Ajayukindip and Ogomoko. When I started following my friend to Ikom for business, my husband had no option than to accept.<sup>45</sup>

#### IV. POLICY RECOMMENDATIONS

This write-up makes a number of recommendations for facilitating cross-border trade that would open up additional opportunities for traders, farmers and the private sector in both countries.

##### i. For the Governments of both Cameroon and Nigeria

The border position of Bakassi to neighbouring Nigeria has launched a paradigm shift representing much sensitivity and insecurity that has disapprovingly been

affecting commercial activities in terms of volume and direction of flow of goods as well as the necessary infrastructure. Border insecurity reached its zenith during the famous Bakassi crisis and lasted over a decade of skirmishes and gun combats with a resultant loss of lives and displacement of people. Such could only but slow down commercial interactions and transactions between Bakassi with Nigeria especially as the numerous outlets/creeks that were hitherto very influential in trading activities prior to the crisis became strategic points for military schemes and assault points of both countries sealing the livelihood of the riverine inhabitants<sup>46</sup> and directly negatively intensifying each time soldiers of Nigeria and Cameroon clashed.<sup>47</sup> This discussion above alludes to the active environments but very porous nature of the borders to maritime transport since most of the roads are earth roads and seasonal and some not just usable for long periods of the year during torrential rains which causes an increase in the prices of basic commodities and consequent economic slowdown in the wet season being a major challenge to the commercial sector dynamics in Bakassi. The fact that the key challenge here is border insecurity and deplorable transport network is just a slender deviation in other parts of Africa like along the Zimbabwe - South African border, where Karolia<sup>48</sup> noted viciousness of the forces of law and order at the border post to be a deterring factor affecting the volume of flow of goods. This is aggravated by cases of sexual harassment as women are forced to engage in transnational sex while their male counterparts are sodomised.<sup>49,50</sup>

<sup>46</sup> Ariye, E.C., "Nigeria, Cameroon and the Bakassi territorial dispute settlement: The triumph of bilateralism", *International Affairs and Global Strategy*, vol. 38, 2015, pp 24-33, at 'www.iiste.org ISSN 2224-574X' in Jude Ndzifon Kimengsi, Zephania Nji Fogwe, Nebota Catherine Mende, "Cameroon-Nigeria ..." p. 18.

<sup>47</sup> Baye, F. M., "Implications of the Bakassi conflict resolution for Cameroon", *Africa Journal on Conflict Resolution*, vol. 10 (1), 2010, pp. 9-34, in Jude Ndzifon Kimengsi, Zephania Nji Fogwe, Nebota Catherine Mende, "Cameroon-Nigeria ..." p. 18.

<sup>48</sup> Chirau, T. J. and Chamuka, P., "Politicisation of urban space: Evidence from women informal traders at Magaba, Harare in Zimbabwe", *Global Advanced Research Journal of History, Political Science and International Relations*, May, 2013, vol. 2(2), pp. 014-026, in Jude Ndzifon Kimengsi, Zephania Nji Fogwe, Nebota Catherine Mende, "Cameroon-Nigeria ..." p. 18.

<sup>49</sup> Tay. N., "Women traders confronting sexual harassment at borders", at 'http://south-south.ipcundp.org/news/item/384-women-traders-confronting-sexualharassment-at-borders', 2010, [Accessed: 2 October 2011], 14pp in Jude Ndzifon Kimengsi, Zephania Nji Fogwe, Nebota Catherine Mende, "Cameroon-Nigeria ..." p. 18.

<sup>50</sup> Matakanye J., "Ten raped on SA border daily: officials" at 'http://www.newzimbabwe.com/news-5187-10%20raped%20on%20SA%20border%20daily%20officials/new

<sup>43</sup> Interview with Chief Ankeh Mbang Ankeh at Kombo Abedimo, 06/04/2020.

<sup>44</sup> Interview with Alice Yacob at Kombo Abedimo, 08/04/2020.

<sup>45</sup> Ndip, Tabi. J., "Women in Trans-Border Trade...", p.166.

The Cameroon government needs to carry out weighty infrastructural developments in the health, education, road, water and telecommunications spheres in Bakassi. This will ease the precarious living conditions of the Bakassi residents and act as incentives for other Cameroonians to accept working there, which oral evidence reveals the latter is hardly the case.<sup>51</sup> This will also help to discourage any social movements that may be encouraging the intention to instigate the Bakassi indigenous people to reject the peace dividends that they stand to achieve from the implementation of the Green-tree Agreement.<sup>52</sup>

For the reason that post crisis dynamics reveal an increasingly unaccounted and unofficial cash crop trade outflow towards Nigeria especially due to the deficiency of practicable road transport infrastructure and warehouses/storage tanks in the Cameroon side, post crisis trade management exhibits the need for our Cameroon government to set in vigorous confidence building measures while urgently boosting the transport and market infrastructure of this our richly endowed peninsula. This will urgently be conforming to the Green Tree Accord which insists on special public investment to enhance trade and commerce among other necessities.

For both governments of Cameroon and Nigeria, a key area for policy reform will be an overhaul of the import and export restrictions that have been existing. However, such reforms will have to overcome significant resistance from those groups benefitting from existing arrangements especially the women of the peninsula of Bakassi. The countries' governments should equally put in place strong institutions that will reinforce cross border trade policies and above all guarantee a stable political and economic climate that will enhance trade and regional cooperation. The revenue collection system has to be computerised at all levels of government in the entire national territories, not just in specific border regions. This will make revenue collection effective and efficient. Informal trade transactions will become increasingly official and recorded. So will the peninsula's economic archives be increased for the benefits of researchers and other stakeholders.

## ii. For Bakassi Women Cross-Border Traders

Formation of Trade Unions and/or Trade related Associations is being recommended. Field evidence

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s.aspx', [Accessed: 2 October 2011], in Jude Ndzifon Kimengsi, Zephania Nji Fogwe, Nebota Catherine Mende, "Cameroon-Nigeria ..." p. 18.

<sup>51</sup> Interviews with Ita Njong, Chief of Akwa 2, in Kombo Abedimo, 9/04/2020; and visualised during field work studies.

<sup>52</sup> Tchouassi Gérard, "Conflict and Women...", p. 171.

demonstrated the individualistic conduction of trade flows by the women in the targeted study area. Consequently, the need for trade unions for traders of both gender as a whole, with more emphasis on those having women as target was emphasized. This was deemed necessary for certain reasons. The existence of trade unions among the Bakassi women embarking on any form of trade with Nigeria will heighten the capacity for receiving grants and subventions from the State. Even non-state organizations notably Non-Governmental Organisations, Inter-Governmental Organisations including individual free will donations will be more plausible.<sup>53</sup>

Equally, it was recommended that these female cross border traders make more use of E-commerce despite the shortage and absence of electricity in many parts of these communities. This more e-commerce engagement was to be made possible in two ways: first, to be exploited by the women already owning generators. Secondly, the repayment of the monthly electricity bill of 1000 FRS<sup>54</sup> was to be taken seriously for its continuous presence. In so doing,, the women will be able to do more marketing and sales with their phones when possible, and equally remain updated about marketing information from Nigerian markets relating to exchange rates and estimates of supply quantities of their goods in these markets before effectuating voyages. This would be going a long way to reducing trade vulnerabilities.

## V. CONCLUSION

The study has endeavoured to examine the different reasons that pushed women of the Bakassi Peninsula in Cameroon to venture into cross-border trade transactions with Nigeria. It was observed that, the reasons were historical, cultural and most especially, economic in nature. All these were grouped up to include intermarriages, differences in natural resources; differences in prices resulting from divergent trade policies; devaluation of the Nigerian currency and the economic crisis of the 1980s. Concerning the constraints faced in the process, they varied from the economic standpoint to socio-cultural restraints. The economic hindrances examined were corruption; piracy/theft; fraud; price instability; transport and communication network problems and inadequate capital. As for the socio-cultural obstructions, they were principally illiteracy, inadequate access to information and traditional prejudices. In other words, the essay portrayed that, in as much as Bakassi women witnessed many constrictions in their desire to

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<sup>53</sup> This recommendation was based on the reality that acting singly, each trader could hardly benefit from grants and aids as compared to being in a group or union.

<sup>54</sup> The dispenser of this information, a member of the BIR (*Battalion Intervention Rapide*), championed for anonymity.

undergo cross-border trade in Nigerian markets, the article was able to attempt reasons why they pushed on or their motivations/ rationales. We were equally able to propose some note worthy recommendations to the governments of both Cameroon and Nigeria on the one hand and specific recommendations to Bakasssi women cross border traders on the other. To the Cameroon government, it was recommended that, infrastructural development and social facilities especially electricity are to be urgently addressed to boost residence in the entire peninsula and curb the ghost worker syndrome. This will eventually promote the volume of cross-border trade with neighbouring Nigeria as a consequence of increased stable population. From this perspective, the governments of both Cameroon and Nigeria are advised to put in place strong institutions that will regulate cross-border trade policies with the absolute computerisation of the revenue collection system to enhance transparency. For those Bakasssi women participating in cross-border trade, the formation of trade unions and other trade related associations was proposed to them. These were seen as a means to maximise team work, minimise trade losses and easily attract grants and aids from state as well as non-state actors. Will these urgent propositions be tested by all the stakeholders concerned?

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# Food Selectivity and Nutritional Conduct in Children with ASD: An Integrative Review

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**keywords**— *Autism, eating behavior, feeding, children, food selectivity*

**Abstract**—*Autism Spectrum Disorder (ASD) is a condition characterized by difficulty in social interaction, in addition to affecting the development of language and communication. Food selectivity is one of the outstanding characteristics in this group, generating significant nutritional deficiencies in children and adolescents with ASD. The objective of this integrative review was to verify, through the available literature, aspects related to the eating behavior and health of children with Autism Spectrum Disorder. Developed in was developed in six steps: 1. elaboration of the research question, 2. definition of the sources of selection of primary studies and the inclusion and exclusion criteria, 3. definition and extraction of data, 4. evaluation of the included studies, 5 • critical analysis of the results, 6. presentation of the synthesis of the evidence found. According to the results presented, about eating problems, it was evidenced that children with Autism Spectrum Disorder are more prone to the development of food selectivity and micronutrient deficiency than children with typical development. In addition to requiring greater involvement and frequency of their parents/caregivers concerning their peers during meals. As is evident the presence of risky eating practices within this group, occurring more frequently among children with ASD than among neurotypical children. Thus, it is suggested the production of more studies on the subject and the development of public policies that cover this group.*

## I. INTRODUCTION

Autism Spectrum Disorder (ASD) is a condition characterized by difficulty in social interaction, in addition to affecting the development of language and communication. Other characteristics are also present in the Disorder, such as restricted, repetitive, and stereotyped behavior patterns in addition to sensory changes and eating problems, being selectivity feeding one of the major causes in the development of nutritional deficiencies and obesity in people with ASD [1].

As mentioned, food selectivity is one of the main existing behavioral changes and is related to a sensory disorder and hypersensitivity to touch that can directly compromise food acceptance consequently, they may have difficulties in processing some information such as texture, pigmentation, flavors, format, temperature, type of packaging, among others [2].

Children with ASD are much more selective and resistant to the introduction of new foods, which makes them more likely to develop eating difficulties that can

lead to nutrient deficiencies, compared to typically developing children. The percentage of autistic children who present food selectivity is perceived on average from 40% to 80% in children with this disorder [3].

Overweight and obesity frequent in children with ASD have been attributed to the repetitive and restricted eating behavior of these children. Due to inadequate diet and lack of energy balance that can directly influence food consumption, thus contributing to overweight [4].

Therefore, the objective of this integrative review is to verify, through the available literature, aspects related to the eating behavior and health of children with Autism Spectrum Disorder.

## II. METHODOLOGY

### 2.2 Type of study

This is an integrative literature review that was developed in six stages: 1. elaboration of the research question, 2. definition of the sources of selection of primary studies and the inclusion and exclusion criteria, 3. definition and extraction of data, 4. evaluation of the included studies, 5. critical analysis of the results, 6. presentation of the synthesis of the evidence found [5].

To prepare the research question, the Population - Interest - Context (PICO) strategy was used, in which P - children with Autism Spectrum Disorder (ASD), I - food selectivity, and eating behavior were considered. Thus, the guiding question was: What aspects are related to the eating behavior and health of children with ASD?

#### 2.2.1 Scenario

The search for primary studies was carried out at the Biblioteca Virtual en Salud (BVS)/BIREME. Using the following descriptors in English: nutrition, autism, and eating behavior. Access to the database took place in December 2021 through the researchers' remote access.

#### 2.2.2 Inclusion criteria

As a method of selecting the articles to compose the review sample, the following inclusion criteria were adopted: primary studies that present topics related to the food selectivity of children with ASD, nutritional management in patients with ASD, nutritional status of children with food selectivity, available in Portuguese and English, and published from January 2017 to December 2021. As exclusion criteria, the following were adopted: dissertations, thesis, and case report.

#### 2.2.3 Data collection

To search the databases, controlled descriptors (terms structured hierarchically, used in the indexing in the databases) of the Medical Subject Headings (MeSH) and Descriptors in Health Sciences (DeCS) were used. The

descriptors were cited in the search of the BIREME database with the AND connector and at the same time, during one week. The search strategy was conducted to contemplate the peculiarities of the database and time restriction filters (last 5 years) were added.

#### 2.2.4 Data analysis

The search for studies, sorting and data extraction were performed by three researchers, who standardized the search strategy in the database and performed it independently, with subsequent comparison of the results found.

The analysis and integration of results were based on the method of data reduction, which consisted of critical reading. And for the theoretical support of the critical analysis of the results, the scientific literature on the subject was used, and these studies were not included in the review. The presentation of results descriptively took place, aiming to promote the incorporation of evidence and the identification of gaps in knowledge.

Table 1: Database search strategy

Base de dados	Search strategy
BIREME	nutrition, autism, and eating behavior

The review variables were categorized in a spreadsheet using the Microsoft Excel 2010 program, containing the following information available in the primary studies: year, country, type of study, objectives, method, and conclusion.

#### 2.2.5 Ethical aspects

The protocol of this study will not be submitted to the Research Ethics Committee, since public access studies available in the scientific literature will be used.

## III. RESULTS

During the manual search in the database, 39 articles were identified. All were selected to read the abstracts. Remaining 16 studies are for a full reading. Of these, 15 studies were linked to Pubmed/MEDLINE and 1 to LILACS. After applying the selection criteria, all 16 studies were included to integrate the research. The main reason for exclusion from the studies was the escape from the theme.

With 93.75% of these linked to Pubmed/Medline. Regarding language, 15 articles were published in English and 1 in Portuguese. Regarding the countries where the research was conducted, 31.25% of the **studies were**

carried out in the USA, 12.5% in Spain, 12.5% in Turkey, and the other countries collaborated with 6.25% of the studies each (Brazil, Poland, China, Australia, South Korea, Malaysia, and India).

Regarding the type of study, 37.5% were cross-sectional and observational studies, 12.5% were case-control studies, 12.5% were exploratory and descriptive studies, 12.5% were systematic reviews, 6.25% were observational

and case studies. -control, 6.25% retrospective review, 6.25% cross-sectional study.

Most of the studies analyzed (95%) reported a high prevalence of food selectivity among children with ASD, as well as a low intake of proteins, fruits, vegetables, and vegetables by them compared to children with typical development. 50% of the studies analyzed described unhealthy eating habits and some micronutrient deficiency among children with ASD. In addition, there are data among the studies that point to a relationship between this food selectivity and the development of malnutrition and other comorbidities.

Among the studies (25%) it was also possible to perceive the role of parents/caregivers during the feeding time of children with Autism Spectrum Disorder (ASD),

and the use of negotiation and reward methods for children to ingest certain foods, and there is a usually greater insistence that the child eats during meals.

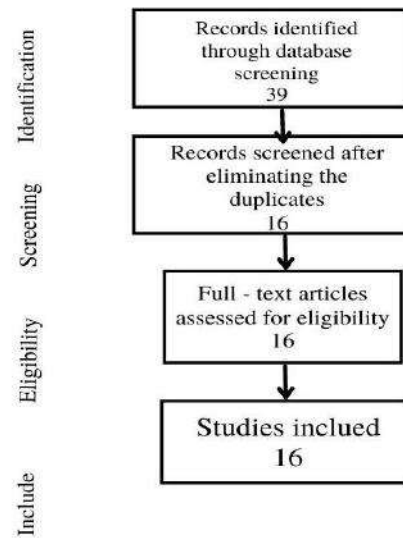


Fig.1: Flowchart of the integrative review articles selection process.

Table. 2 present the types of studies, methodology, objectives, results, and conclusion of the primary studies.

Table.2: Synthesis of the articles selected for the integrative review.

TYPE OF STUDY	TITLE	AIM	METHODOLOGY	RESULTS	CONCLUSION
Cross-sectional and observational study	Feasibility of virtual nutrition intervention for adolescents with an autism spectrum disorder [6]	This study aimed to examine the feasibility of a virtual implementation of Bringing Adolescent Learners with Autism Nutrition and Culinary Education, an 8-week nutritional intervention based on the social cognitive theory that addresses specific eating	The implementation process was measured with loyalty checklists, engagement logs, and field notes. The feasibility of virtually evaluating adolescent outcomes (food frequency questionnaire, psychosocial survey, height, and weight) was also evaluated. Adolescents with autism spectrum disorder aged 12-21 years were recruited through a local community partner.	Six groups (n = 27; group size ranged from 2 to 7) participated. Univariate data analyzes were performed. Mean class attendance was 88%, participation was 3.5/4 (4 = Often), completion of homework was 51.9%, fidelity was 98.9%, and the prevalence of	Data quality was high for 88% of food frequency questionnaires and 100% of psychosocial surveys. The results suggest that a virtual implementation and assessment of adolescent students with autism through nutrition and culinary education was feasible. It can be implemented virtually to reach diverse

		behaviors on the autism spectrum and dietary challenges.		technical difficulty was 0.4 / 2 (2 = Major technical difficulties). The assessment completion rate was 100% (98.9% – 100%) at baseline and 92.6% –96.3% (99.5% – 100%) post-intervention.	populations of adolescents with an autism spectrum disorder.
An observational and case-control study	Dietary Patterns, Eating Behavior, and Nutrient Intakes of Spanish Preschool Children with Autism Spectrum Disorders [7].	The present study aimed to determine the PDs and macro and micronutrient intake in a sample of Spanish preschool children with ASD compared with typically developing control children.	Fifty-four children with ASD (two to six years of age) diagnosed with ASD according to Diagnostic Manual criteria-5) and a control group of 57 typically developing children of similar ages were recruited. A validated food frequency questionnaire was used, and energy and nutrient intakes were estimated using three non-consecutive 24-hour dietary records. PDs were evaluated using principal component analysis and hierarchical cluster analysis	Children with ASD exhibited a PD characterized by high intakes of energy and fat and a low intake of vegetables and fruits. Likewise, consumption of any type of meat, both lean and fatty, was associated with higher consumption of fish and dietary fats. In addition, increased consumption of dairy products was associated with increased consumption of cereals and pasta. In addition, they often consumed industrialized	In conclusion, this study emphasizes the need to assess the PDs and nutrient intake of children with ASD to correct their alterations and rule out some potential nutritional diseases.

				products of low nutritional quality, such as beverages, sweets, snacks, and bakery products. The percentages of children with ASD who meet the adequacy of nutrient intake were higher for energy, saturated fat, calcium, and vitamin C, and lower for iron, iodine, and B vitamins when compared with control children.	
Retrospectivereview	Intensive multidisciplinary feeding intervention for patients with avoidant/restrictive food intake disorder associated with severe food selectivity: An electronic health record review [8].	The purpose of this study was to examine the clinical presentation, intervention characteristics, and treatment outcomes for young children who received IMI for restrictive food avoidant eating disorder (ARFID) involving nutritional insufficiencies associated with severe food selectivity.	The statement on Strengthening the Report of Observational Studies in Epidemiology was followed to conduct this retrospective chart review. The review focused on consecutive patients (birth to 21 years) admitted to the IMI program over 5 years (June 2014 to June 2019). Inclusion criteria called for micronutrient insufficiencies (vitamins A, B12, C, D, E; folic acid; calcium; iron; and zinc) and chronic mealtime refusing behavior (e.g., turning the head	During the 5 years, 63 of the patients met the study entry requirements. Of these, 60 patients (50 boys and 10 girls; mean age = 72 ± 39 months; range = 23–181) completed the intervention (95% treatment completion rate). At discharge, dietary diversity improved in 16 new therapeutic foods (range: 8–22), rapid	The results of the current study support the benefits of IMI for increasing food variety, improving mealtime behaviors, and increasing nutritional intake in children with ARFID who have severe food selectivity.



			away from food) / spoon, push or throw the spoon, cry, scream and leave the table) associated with severe food selectivity.	acceptance and swallowing of new foods exceeded clinical standards (80% or > bites), and the risk of nutritional inadequacies decreased for this cohort of patients.	
Cross-sectional study	Parental Reports on Early Autism Behaviors in Their Children with Fragile X Syndrome as a Function of Infant Feeding [9].	This study aimed to evaluate the prevalence of autistic behaviors in fragile X syndrome as a function of children's diet.	We analyzed retrospective research data from the Fragile X Syndrome Nutrition Study, which included data on infant feeding and caregiver-reported developmental milestones for 190 children with Fragile X syndrome enrolled in the Fragile X Online Registry With Accessible Database (FORWARD).	Sex-specific exploratory associations were found linking soy-based infant formula use with worse autistic language-related behaviors in women and self-injurious behavior in men. These findings lead to a prospective assessment of the effects of soy-based infant formula on disease comorbidities in fragile X syndrome, a rare disorder for which newborn screening could be implemented if there were an intervention.	Gastrointestinal problems were the most common reason for switching to soy-based infant formula. Thus, these findings also support the study of early gastrointestinal problems in fragile X syndrome, which may underlie the development and severity of disease comorbidities. In conjunction with comorbidity data from previous analyzes of the Fragile X Syndrome Nutrition Study, the results indicate that mothers with premutation fragile X children should be encouraged to breastfeed.

Case-control study	Eating Behaviors of Children with Autism-Pilot Study [10].	This study aimed to assess the nutrition of children with autism, with particular emphasis on feeding in the first year of life, compared to the healthy peer group.	Participants included 75 white children (41 children diagnosed with pure autism and the control group consisting of 34 children without autistic traits). The analysis was carried out based on a self-designed questionnaire, the first part being dedicated to early childhood feeding practices.	Results: $p = 0.04$ ), late introduction of dairy products ( $p = 0.001$ ), need for more trials to introduce new foods ( $p = 0.006$ ), late introduction of foods with a solid and granular structure ( $p = 0.004$ ), longer bottle feeding time ( $p = 0.005$ ); delay in trying to eat with one's own hands ( $p=0.006$ ) and need for greater support from parents to divert attention from eating during feeding ( $p=0.05$ )	It was concluded that: 1. Eating problems are more common among children with autism spectrum disorder than among the population of healthy children during the first year of life after the introduction of complementary foods. 2. Autistic children have difficulty eating and require additional parental involvement much more often than their healthy peers.
Cross-sectional and observational study	An investigation of the relationship between the eating behaviours of children with typical development and autism spectrum disorders and parent attitudes during mealtime eating behaviours and parent attitudes during mealtime [11].	The present study aimed to determine the PDs and macro and micronutrient intake in a sample of Spanish preschool children with ASD compared to a control group of typically developing children of the same age.	A total of 180 parents of children aged between 3 and 5 years in Ankara participated in the study; 90 were parents of children with TD and 90 were parents of children with ASD. The variables were measured using the Brief Assessment of Mealtime Behavior in Children (BAMMIC), the Child Eating Behavior Questionnaire (CEBQ), and the	The results revealed that food refusal, disruptive behaviors, and limited variety in children with TD were related to parental actions, such as the use of rewards. We also found a negative correlation between the enjoyment of food and the use of	Despite the differences, the eating behaviors of children with TD and ASD show similarities in some cases. If a child has little interest in eating, parents tend to be pushier, use more rewards, and offer special meals. On the contrary, the child's great interest in eating impairs the parents' behavior. As the

			Parent Meal Action Scale (PMAS).	rewards. Children with ASD showed differences in food refusal, and their parents prepared more special meals for them compared to children with TD.	recognition that there is a relationship between children's eating behaviors and parental actions could make it easier for intervention to shape attitudes through parents, it is recommended that future studies be carried out to respond to children's eating problems, working together with your caregivers.
Case-controlstudy	Eating Behaviors and Diet Quality in Chinese Preschoolers with and without Autism Spectrum Disorder: A Case-Control Study [12].	To compare mealtime behaviors and diet quality in Chinese preschoolers with autism spectrum disorder (ASD) and typically developing preschoolers in Hong Kong.	This study included a community sample of 65 families with preschool children with ASD aged 3-6 years and 65 families with preschool children with typical development matched for age and sex. The eating behavior of preschoolers was assessed using the Brief Autism Mealtime Behavior Inventory and the Preschoolers' Eating Behavior Questionnaire (CPEBQ). Preschoolers' usual diet and nutrient intake were assessed using a validated food frequency questionnaire. Diet quality and diversity	Compared with the typically developing group, the ASD group had higher scores in the food refusal domain of the Brief Mealtime Behavior Inventory (P<0.001), the CPEBQ food agitation domains (P=0.001), and eating habits (P=0.001). P=0.001, and lower CPEBQ exogenous feeding score (P=0.003) and initiative feeding score (P<0.001).	Preschool-aged children with ASD showed more feeding and mealtime problems, and lower diet quality and diversity than their typically developing counterparts. Our results highlight the need for regular monitoring and early identification of behavioral and nutritional problems during meals among preschool children with ASD.

			<p>were generated using the Chinese Children's Food Index total score and the diet variety score. Differences between groups on various scales and dietary variables were examined using linear regression or multivariate logistic models adjusting for baseline demographic differences.</p>	<p>The Chinese children's total Food Index score ( P = 0.001) and diet variety score ( P = 0.005) and intake of soy and soy products ( P = 0.001) were lower in the ASD group compared with the typical development group.</p>	
<p>Cross-sectional and observational study</p>	<p>The nutritional behavior of children with autism spectrum disorder, parental feeding styles, and anthropometric measurements [13].</p>	<p>The objective was to evaluate the nutritional behavior, anthropometric measures, and feeding styles of caregivers of children with ASD.</p>	<p>104 children with ASD and 100 controls were included in the study. The children's weight and height were measured and recorded by the researchers. The Infant Feeding Behavior Questionnaire, the Parental Feeding Style Questionnaire, the Developmental Assessment Form, and the Sociodemographic Data Form were administered by their caregivers.</p>	<p>Children with ASD were difficult to feed as infants, experienced more problems transitioning to complementary feeding, were more selective about food, and were fed diets with a more limited variety than the control group. The BMI z-scores for children with ASD were higher than those for children without ASD, while their height z-scores were lower. Children with ASD exhibited more</p>	<p>Children with ASD are more selective about foods and have a harder time switching to complementary foods. The BMI-z score for children with ASD is higher and the z-height score is lower. Children with ASD have different eating and eating styles compared to children in the control group.</p>

				<p>responsiveness to food, emotionally overeating, appreciating food, cravings for drinks, undereating, and food-selective behaviors, whereas parents of these children used more emotional eating, instrumental eating, and tolerance-controlled eating styles than the parents of the controls.</p>	
<p>An exploratory and descriptive study</p>	<p>Young Adults with High Autistic-Like Traits Displayed Lower Food Variety and Diet Quality in Childhood [14].</p>	<p>This study aimed to explore the association between autistic-like traits in young adults and early childhood food intake in the Gen2 Raine Study cohort.</p>	<p>Data were collected from available information from 811 participants at 1, 2, and 3 years of age for the assessment of dietary intake, and at 20 years of age for the measurement of autistic-like traits.</p>	<p>Results showed that as autistic-like traits increased, total food variety, staple food variety, and dairy variety decreased (<math>p &lt; 0.05</math>), with lower consumption of citrus fruits and yogurt (<math>p &lt; 0.05</math>). both <math>p = 0.04</math>). As autistic-like traits increased, diet quality decreased, this trend was significant at 2 years (<math>p = 0.024</math>).</p>	<p>From the results, it is suggested that young adults with higher autistic-like traits were more likely to have lower food variety and quality in early childhood.</p>

<p>Cross-sectional and observational study</p>	<p>Increased emotional eating behaviors in children with autism: Sex differences and links with dietary variety [15].</p>	<p>This study aimed to examine emotion-related overeating and undereating based on parental assessments of these behaviors in children aged 4 to 17 years with autism spectrum disorder compared to typically developing children of the same age.</p>	<p>A total of 190 children aged 4 to 17 years with Autism Spectrum Disorder were selected and 119 typically developing children of the same age were selected, and the assessment was made from the point of view of the parents or caregivers of these children.</p>	<p>Children with autism spectrum disorder were rated as exhibiting more emotional eating behaviors and more eating than their normally developing peers. Furthermore, although sex differences in these emotional eating behaviors were not seen in typically developing children, girls with autism spectrum disorder were rated as having more emotional eating behaviors than boys with an autism spectrum disorder.</p>	<p>It is concluded that among all children with autism spectrum disorder, excess emotional eating was related to increased consumption of sweet foods and decreased consumption of vegetables. These findings have implications for a better understanding of eating habits in children with autism spectrum disorder and suggest that emotional eating behaviors can have immediate and later health impacts.</p>
<p>Systematic review</p>	<p>Nutritional Deficiency Disease Secondary to ARFID Symptoms Associated with Autism and the Broad Autism Phenotype: A Qualitative Systematic Review of Case Reports and Case</p>	<p>The primary objective of this review was to examine the relationship between the demographics, weight status, dietary patterns, and nutrient deficiency illnesses that characterize the most severe</p>	<p>A systematic review of articles in English and non-English published until August 29, 2019, in the electronic databases Scopus, PubMed, and Cumulative Index to Nursing and Allied Health Literature Plus was performed. Additional cases were identified</p>	<p>A total of 76 cases (patients aged 2.5 to 17 years) from 63 articles published from 1993 to 2019 were found. More than 85% of the cases (65 of 76 patients) were articles published in</p>	<p>Based on the 63 articles extracted for this systematic review, nutritional deficiency diseases related to inadequate intake of vitamin A, thiamine, vitamin B-12, vitamin C, and vitamin D were</p>

	Series [16].	manifestations of avoidant/restrictive eating disorder symptomatology associated with autism or the broad phenotype of autism. autism.	through the reference list of all included articles. The search terms used were "autism * AND (deficiency OR scurvy)". Only case reports or case series were included in which a person of any age who was identified as having a formal diagnosis of autism or symptoms of autism and a nutritional deficiency disease due to self-imposed dietary restrictions were included. Data were independently extracted by 8 authors using predefined data fields.	the last 10 years. The highest percentage of published cases (69.7% [53 of 76]) involved scurvy, a vitamin C deficiency. The second-highest percentage of published cases (17.1% [13 of 76]) involved eye disorders secondary to the deficiency of vitamin A. Other primary nutrient deficiencies reported were thiamine, vitamin B-12, and vitamin D. In 62.9% (22 of 35) of patients who were given a body mass index or weight percentile for age, the patient was within normal weight parameters, per the Center for Disease Control weight status categories.	found in individuals with autism and broad autism phenotype who had severe autism. - dietary restrictions imposed. When weight information was provided, most youths in these cases were not reported to be underweight. Individuals of any weight who exhibit symptoms of avoidant/restrictive eating disorder may benefit from early and frequent screening for adequacy of micronutrient intake, regardless of whether they have a clinical diagnosis of autism.
Exploratory/Descriptive/Qualitative study	Food and nutritional aspects of children and adolescents with	Understand the eating habits, difficulties, and strategies of children and	The study is characterized by presenting a qualitative approach of the exploratory	The data collected in the work were separated into 3 thematic	Adolescents and children with ASD have difficulties in sensory

	<p>an autism spectrum disorder [17].</p>	<p>adolescents with autism spectrum disorder (ASD).</p>	<p>and descriptive type, it was conducted with the help of a semi-structured interview with 14 parents of children with ASD who study in a specialized education school, the research was carried out from April to May 2019 in a city in southern Brazil.</p>	<p>categories: eating habits of children and adolescents with ASD; eating difficulties of children and adolescents with ASD; and dietary strategies for children and adolescents with ASD. It was identified from the parents' reports that only 8.8% of children and adolescents had healthy eating habits, 1.6% of them had good eating behavior, while 16.8% of children and adolescents had unhealthy eating habits. healthy high consumption of ultra-processed foods. The second category identified 9.6% with reported binge eating, the main behaviors of food rejection identified by parents were food refusal</p>	<p>activities, making healthy eating habits difficult, in addition to having a high consumption of ultra-processed foods, eating difficulties with low acceptance of foods with solid consistency, and, therefore, they tend to have unhealthy eating habits.</p>
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				(14.4%) and decreased acceptability for solid foods (13.4%), among the most common symptoms caused by difficulty in eating, 15.9% were found to have disorders in the Gastrointestinal Tract (SGI), followed by lactose intolerance (4.8%) and emesis (3.8%). In the third category, there were low percentages about the dietary strategies made with children and adolescents with ASD.	
Cross-sectional and observational study	Mealtime Behaviors and Food Preferences of Students with Autism Spectrum Disorder [18].	Identify mealtime behaviors and age-based food preferences in students with ASD to prevent problematic eating behaviors and promote healthy nutrition for proper development.	The study was conducted using an online questionnaire that aims to identify mealtime behavior and food preferences. Participants were 130 parents of students with ASD who were studying at a school in Seoul, South Korea from January 30 to February 17, 2020.	The average age of the students was $14.1 \pm 6.1$ , the analysis of problematic behavior during meals was divided into levels, cluster 1 of low level, cluster 2 of medium level, and cluster 3 of high level. According to the WHO BMI criteria, 30.8% were	The study is characterized by presenting a qualitative approach of the exploratory and descriptive type, it was conducted with the help of a semi-structured interview with 14 parents of children with ASD study in a specialized education school, the research was carried out in April to May

				underweight, 40.8% were normal, 15.4% were overweight and pre-obese, and 13.1% were obese. The data collected showed that cluster 3 had a high level of problematic behavior, 66% were younger than 10 years old and had a low food preference.	2019 in a city in southern Brazil.
Qualitative/Transversal type research	Exploring Eating and Nutritional Challenges for Children with Autism Spectrum Disorder: Parents and Special Educators Perceptions [19].	Explore nutritional knowledge among parents and special educators of children with ASD and how this is reflected in their food provision practice through a qualitative approach	The study is characterized by being cross-sectional and qualitative, where semi-structured focal discussions (FGDs) were carried out with 20 participants who were parents and educators of children with ASD at the National Autism Center in Malaysia to identify understanding about a healthy diet.	The inductive analysis linking the codes to the main categories was made from comparisons of the collected data. The study indicated little knowledge about healthy eating and especially about adequate nutritional needs for children with ASD.	The study identified little information from parents and educators related to the health of children with ASD regarding adequate food and nutrition, therefore, an educational tool was suggested to assist parents and educators in implementing a healthy lifestyle for children with ASD
Systematic review	Differences in food consumption and nutritional intake between children with autism spectrum disorders and typically developing	To determine the general differences in nutritional intake and food consumption between children with autism spectrum	The study is a Systematic Review performed on the PubMed/Medline databases and the Cochrane Library databases by the MOOSE guideline for systematic reviews and meta-	19 studies were included in the study, in which there was low protein intake (standardized mean difference = -0.27, 95%	The study showed that children with ASD had lower intakes of foods rich in protein, calcium, phosphorus, selenium, vitamin D,

	<p>children: A meta-analysis [20].</p>	<p>disorder and control (typically developing) children, as well as to determine the extent to which the nutritional intake and food consumption of autistic children meet dietary recommendations.</p>	<p>analyses of observational studies and the PRISMA Guideline for preferred reporting.</p>	<p>confidence interval (-0.45, -0.08)), calcium (-0.56 (-0.95, -0.16)), phosphorus (-0.23 (-0.41, -0.04)), selenium (-0.29 (-0.44, -0.13)), vitamin D (-0.34 (-0.57, -0.11)), thiamine (-0.17 (-0.29, -0.05)), riboflavin (-0.25 (-0.45, -0.05)) and vitamin B12 (-0.52 (-0.95, -0.09)) plus polyunsaturated fatty acid (0.27 (0.11, 0.44)) and vitamin E (0.28 (0.03, 0.54)) than the controls. They had lower intakes of foods rich in omega-3 (-0.83 (-1.53, -0.16)) and higher intakes of fruits (0.35 (0.12, 0.59)) and vegetables (0.35 (0.09, 0.61)) compared to children in the control group.</p>	<p>thiamine, riboflavin, and vitamin B12 and higher intakes of PUFA, vitamin E, and fruit and vegetables compared to the control group. According to the recommendation of the DRI, children with ASD may be at risk of deficient intake of calcium, vitamin D, and dairy products, but it is understood that the results are based on a limited number of studies, requiring studies with larger samples.</p>
<p>Prevalence/Cross-sectional/Observational study</p>	<p>Dietary patterns and anthropometric</p>	<p>This study aimed to focus mainly on diet</p>	<p>Food intake and behavior problems during meals were</p>	<p>The study showed that 85% are male</p>	<p>The work was characterized by being a pilot</p>

	<p>measures of Indian children with an autism Spectrum disorder [21].</p>	<p>patterns and their impact on children's somatic status with ASD.</p>	<p>analyzed in 53 children with ASD aged 2 to 13 years, characterized by a pilot, cross-sectional and observational study carried out at the All India Institute of Speech and Hearing (AllSH), which is located in India from January to April 2016, with the help of 3-day Food Records, Child Behavior Inventory and Food Frequency Questionnaire.</p>	<p>and 15% are female, according to the Indiana Scale for Autism Assessment (ISAA) of the 53 children with ASD, 28.3% are mild, 62.2% moderate, and 9.4% severe. The highest percentage according to the age group is children between 2-4 years old (37%), in short, the age group ranged from 2 to 13 years old. Boys aged 2 to 5 years had higher percentages of overweight (13%) while most boys aged 6 to 13 years (15%) were underweight while most girls had adequate weight in both age groups. According to food intake, it was observed that there was lower consumption of fruits and vegetables, thus indicating smaller</p>	<p>study and identified little food variety to the low consumption of fruits and vegetables by children, in addition to overweight and low weight rates, which suggest future studies. The psychosocial difficulties about the acceptance of parents make it difficult to seek early specialized and multidisciplinary care. It is emphasized that micronutrient deficiency issues can have several negative repercussions for health, in addition to healthy eating being a factor of great importance for multidisciplinary work and for improving the health of children with ASD.</p>
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				amounts of B vitamins, minerals, especially calcium and iron in the diet of children with ASD. It was suggested the need to implement programs related to nutrition and feeding of children with ASD in the Mysuru region, India.	
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#### IV. DISCUSSION

##### 4.1 Nutritional Status

According to ŞENGÜZEL et al. [22] children with ASD had a higher percentage of obesity in relation to the population of children who were not on the spectrum. TOSCANO et al. [23], based on a longitudinal approach conducted in Brazilian children and adolescents with ASD, showed growth retardation in children between 8 and 9 years of age, at the beginning of the puberty phase, and BMI below the recommended, affecting, therefore, pubertal growth. The problem was mainly due to food selectivity; in addition, there was a high rate of overweight in early childhood, especially due to the absence of physical exercise and the psychomotor difficulties of children with ASD.

TKACHUK, MARTYNOVICH, and GLOBENKO [24] state that other factors have a great influence on BMI and body adiposity, especially gastrointestinal disorders, as diseases of the Gastrointestinal Tract (GIT) are common in this population and alter the microbiota, immune response, and functionality of the Gastrointestinal System (SGI). Psychotropic medication prescribed to treat behavioral aspects, as well as sleep disorders, may be related to the inadequacy of the nutritional status of children with ASD [23].

Severe food selectivity does not only affect the intake of macronutrients in the diet but also, according to SHARP et al., (2018), represents a high-risk factor for nutritional inadequacies related to micronutrients,

especially in the levels of vitamin D, vitamin E, and calcium in addition to the low consumption of dietary fiber. In the studies by TKACHUK, MARTYNOVICH, and GLOBENKO [24], nutritional deficiencies of minerals such as potassium, calcium, and lithium increased the incidence of neuropsychiatric symptoms in children with ASD, in addition to altering endocrine and metabolic aspects and delaying the evolution of physical and mental development. in these individuals. Therefore, programs aimed at tracking and monitoring the nutritional deficiencies of children and adolescents with ASD are of great importance to prevent the negative effects triggered by these nutritional deficiencies.

##### 4.2 Eating Habits

According to studies on behavior and food selectivity by SHARP et al. [25], caregivers of children with ASD indicated that they have low consumption of vegetables and fruits. According to studies by ŞENGÜZEL et al. [22], which aimed to examine factors related to eating disorders and the incidence of obesity in children with ASD, indicated higher percentages of food refusal among children aged 2 and 5 years, which influenced decreased consumption, especially in the fruit group. , vegetables, yogurts, eggs, and cereals, in addition, children had a high consumption of milk, and foods rich in carbohydrates. The selectivity and food refusal of children and adolescents with ASD, especially the low acceptance of foods with solid consistency, and the decrease or rejection of the consumption of natural foods together with the increase in the intake of foods with high concentrations of simple carbohydrates and saturated fats represent risk

eating habits for the development of NCDs, especially obesity.

#### 4.3 Behavior and Food Selectivity

Food selectivity in children with ASD is described in the literature as one of the causes for greater food restriction, which can lead to micronutrient deficiencies and/or the development of Chronic Noncommunicable Diseases, especially obesity [20].

And according to one of the articles analyzed in this review, Plaza-Diaz et al. [26], in a study on eating patterns of children within the Autism Disorder Spectrum, realized that children with ASD had a PD (Eating pattern) characterized by relatively high consumption of cereals, pasta and dairy products and a small intake of lean meat and eggs compared to the SENC (Spanish Society of Community Nutrition) guidelines, and all children, both in the control and TEA groups, consume few fruits, vegetables, and fish. And about the group of children with ASD, there is a large intake of fatty meat and its derivatives, in addition to drinks, snacks, sweets, confectionery, and pureed foods compared to children in the control group. Such behavior is encouraged throughout the lives of children with ASD, since as they grow, they restrict food more, worrying their parents/caregivers and leading them to use these foods as a means of reward for eating certain healthier foods, or in more severe cases of selectivity, being the only food that the child tolerates.

However, the recommendation for the introduction of food is to offer foods with different textures, adjusted to the child's developmental skills about feeding, such as sucking, swallowing, biting, chewing, as well as small motor skills. At first, the texture should be smooth, then lumpy. In the 9th month, food should be, and the soft parts of food should be placed in the child's hands. From the 12th month of life, at least, the child should eat at the family table, which means that no more restrictions on the textures of the products given to the child should be maintained, regardless of whether it is a child with ASD or with typical development, however, research indicates that the introduction of solid foods for children within the Autism Spectrum is carried out later than generally recommended [10]. Data that may explain the high selectivity for this group throughout life, as well as aspects related to olfactory sensitivity, could also be linked to the development of this characteristic.

#### 4.4 Nutritional Conduct

Children's eating behaviors are shaped throughout the developmental period, starting from the prenatal period. Genetic predispositions, the family environment, and their eating behaviors, educational institutions, as well

as the mass media affect children's eating patterns. Thus, children within the Autism Spectrum would be no different, but their high food selectivity requires special attention from professionals to avoid possible nutritional deficiencies [27](DE COSMI; SCAGLIONI; AGOSTINI, 2017).

According to CASSEY et al. [28] in their observational and descriptive study among students diagnosed with ASD and students with typical development in a school, the use of a "Good Behavior Game", seeking to promote the consumption of fruits and vegetables, showed encouraging results, since students developed autonomy in choosing more nutritious foods through the approach. Although according to the authors, the method needs to be implemented in larger groups, the method demonstrated that the use of integrative and playful practices could be promising ways to reduce food selectivity not only in children with ASD.

As a treatment of food selectivity, the conduct that has shown the most positive results in the clinical environment is Sensory Integration Therapy, the approach acts in the creation of appropriate stimuli for children with ASD, where these sensory experiences should help in the development of adaptive responses to the means, for a process of adequate interpretation, concerning the senses: touch, smell, taste, hearing, and vision. For a harmonious development and functioning of the central and peripheral nervous system, including motor skills and agility, visual and auditory perception are the bases for the development of communication skills, that is, dysfunction at any of these levels will result in psychological deficits sensory and motor, including speech and communication deficits [29]. In our study, it was possible to perceive the high prevalence of food selectivity among children with ASD, as well as measures that can help to improve this behavior were presented, as described by BURO et al. [6] in their observational and analytical study with adolescents with ASD, the results suggested that a virtual implementation of Culinary Education can be used to reach different populations of adolescents with Autism Spectrum Disorder, presenting satisfactory results, and improves the diet of this public, as it promotes interaction with food and increased acceptability.

Based on the analysis by BRZÓSKA et al. [10] the introduction of complementary foods into the diet of infants is significantly more difficult in children with ASD. It has been described that children with autism, as well as children without developmental deficits, mostly ate with the family, this fact led to challenging eating difficulties for parents and other family members, significantly increasing the level of stress as well as decreasing the self-

assessment of parental competence. The feeding process requires multiple attempts and special involvement from parents/caregivers in the form of playing with the child or redirecting the child's attention from food to devices such as TVs, computers, or tablets to facilitate feeding and happens most often with children with ASD than with healthy children.

The findings described above corroborate the data in the literature on the subject, confirming the importance of working together between health professionals and parents/caregivers to reduce food selectivity among children with ASD.

## V. CONCLUSION

Regarding eating problems, it was evidenced through the analysis of this review that children with autism spectrum disorder are more prone to the development of food selectivity and micronutrient deficiency than children with typical development. In addition to requiring greater involvement and frequency of their parents/caregivers in relation to their peers during meals. As is evident the presence of risky eating practices within this group, occurring more frequently among children with ASD than among neurotypical children. Thus, it is suggested the need for early identification of nutritional inadequacies in children with ASD, and the development of more studies to evaluate food consumption, selectivity, and micronutrient intake, therefore, there is a need to create obesity programs for children and adolescents. adolescents with ASD, and Food and Nutrition Education Programs aimed at educators and caregivers of children with ASD, aimed at improving the health and quality of life of these individuals, improving their physical and mental development, and reducing the risk of developing Chronic Diseases.

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# The cause of Kabul's environmental problems is its impact on economic and human health

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**Keywords—** *Kabul Afghanistan,  
Environmental Problems, Health effect,  
Economic Effect.*

**Abstract—** A careful examination of the current situation of shows that the Kabul capital of Afghanistan suffers from many environmental problems such as solid waste management, Destruction of protected areas, and air/water pollution. over the past two decades, are acceleration in urbanization, population growth, poverty, war, unhealthy management, and the government's lack of attention to the environment are the main causes of environmental problems in Kabul, at cause A rapid increase in energy consumption, Fossil fuels, and biofuels, and motorization, Elimination of green areas. main air pollution Particulate matter (PM) is the most serious air pollutant in Kabul levels were several times higher than the World Health Organization. one-third of its population has access to the water supply network. public sanitation system does not exist in the city, which leads to contamination of the groundwater in the city. Another major environmental problem in Kabul is the management of solid waste, as well as wastewater management, which has polluted the soil and air/water, there is no type of wastewater treatment without any treatment wastewater entering the stream. also, there is no solid waste collection, disposal, and recycling mismanagement in Kabul. According to assessments, air/water pollution, solid waste and wastewater pollution is the cause of death and morbidity also have an economic effect. Environmental problems can be curbed by enforcing environmental laws Cooperation between the government and national and international organizations and people's participation in protecting the environment.

## I. INTRODUCTION

The effects of human activities on the environment is one of the most important global issues today. Human activities have caused environmental problems. Global warming due to greenhouse gases, air/ water pollution, erosion, etc. Population growth, growth Improper urbanization,

substandard agriculture has destroyed the environment. <sup>[1]</sup> Environmental pollution is directly related to the country's economy; a stable environment is needed for a sustainable economy. <sup>[2]</sup> Environmental degradation endangers the security of future generations and negatively affects present generations. Pollution of water, soil, air, solid waste, sewage, causes various diseases such as malaria,

encephalitis and also causes the death of children and the economy of the people. And endanger the country economic. [3] Kabul is capital of Afghanistan suffer from many environment problems such as air/water pollution, solid waste, swage management, Deforestation and erosion.[4] Water pollution in Kabul due to discharge of sewage in the sea and streams and excessive abstraction of groundwater is the main cause of water pollution in the city. [5] Kabul groundwater Between 2008 and 2016, it decreased by an average of 1.7 meters per year. [6] Air pollution in Kabul is serious and in recent years has been on the headlines of national and international news. The health of the people of the city has brought diseases such as respiratory, heart disease, pus diseases, cancer, asthma in Kabul city due to air pollution and the main causes of this pollution are cutting down trees, fossil fuels, using old cars. [7] Waste solids in Kabul city is a big problem of the government that in recent years with population growth and influx of people from other provinces to the city center for other different reasons, the production of solid waste has increased because there is no sound management. It has caused many problems for the people of Kabul due to the collection and disposal of waste. [8] Lack of sewage collection and treatment system is a big crisis in Kabul city because sewage has entered the water stream without treatment and because of this Kabul city is facing water pollution. Death of children, various diseases due to this water pollution.[9] In this article, we analyzed the environmental problems of Kabul city, as well as the causes and factors of the problems and its impact on the health and economy of the people of Kabul.

## II. DATA COLLECTION AND METHODS

A baseline analysis of urban environmental problems in Kabul is founded on data collected through online interviews and questionnaires, as well as an examination of relevant, existing, and relevant literature. We obtained the data for this study from various sources of existing literature, government policy documents, and reports of international and national organizations concerned with urban environmental problems. These documents demonstrated the current state of environmental problems in Kabul. A web search in electronic databases, can provide various concepts related to urban environmental issues. reports and policy documents of international and national organizations provide data on environmental problems, pollutions, population, Poverty in Afghanistan, especially in the city of Kabul (BBC, WHO, UN, UNSEF, UNESCO, AIE) reported. Published documents on issues related to urban environmental problems including existing articles, books and TV reports Was reviewed for this study.

## III. SCOPE AREA OF KABUL AFGHANISTAN

Kabul capital of Afghanistan with area of 1008.7km<sup>2</sup>, with 1791 m high above the see level it makes one of high city around the world. Kabul is located between 69.2 degrees east and 34.5 North degrees. Kabul has 22 districts, which 19 It has an area of more than 130 km. In this article, the study of environmental problems in the specific geographical area.



Fig. 1: location map of the study area and some air, soil, water, sewage and solid waste pollution.

## IV. MAIN ENVIRONMENT PROBLEMS IN KABUL

Kabul has seafaring from many environmental problems such as air pollution, water pollution soil

pollution, noise pollution, swage and solid waste management and degradation of protected areas.

### 1.1. Air Pollution of Kabul City

Kabul city is one of the top ten air polluted city in the world. [10] During the last two decades, there has been enormous acceleration in urbanization, population growth, poverty, industrialization, as well as a rising level of energy use and motorization. As a result, air pollution has deteriorated significantly due to a variety of increased sources. Due to Afghan government in capabilities to manage air quality and lack of standards for indoor and outdoor air quality, air pollution remains a significant

environmental and health threat. PM<sub>2.5</sub> and PM<sub>10</sub> (Kabul main air pollution) were the most serious pollutants, followed by nitrogen dioxide (NO<sub>2</sub>) and sulfur dioxide (SO<sub>2</sub>). Particulate matter (PM), sulfate of nitrogen (SO), and nitrogen oxide (NO) levels were several times higher than WHO air quality guidelines, whereas the levels of zone (O<sub>3</sub>) and carbon monoxide (CO) were below WHO standards. the air quality index shows in **Table:1**.

Table:1. average air quality index. (WHO 2020<sup>[11]</sup>)

pollutants	Unit	Time-weighted average	in real time Kabul air quality	WHO recommended limit
PM <sub>2.5</sub>	µg/m <sup>3</sup>	24 hours	195	25
PM <sub>10</sub>	µg/m <sup>3</sup>	24 hours	178	50
O <sub>3</sub>	µg/m <sup>3</sup>	8 hours	54	100
NO <sub>2</sub>	µg/m <sup>3</sup>	1 hours	305	200
SO <sub>2</sub>	µg/m <sup>3</sup>	24 hours	75	20
CO	µg/m <sup>3</sup>	1 hours	18	30

The average PM<sub>2.5</sub> and PM<sub>10</sub> are concentration in Kabul air was 195&178 µg/m<sup>3</sup> (24 hours) which exceeded the WHO recommended limit of 25&50 µg/m<sup>3</sup> (24 hours) it shows eight and four time higher for PM<sub>2.5</sub>&PM<sub>10</sub> then WHO limit recommended The principal sources of particulate matter in Kabul are vehicular emissions, particularly from diesel vehicles, burning coal and wood, dust, thermal generators, and residential combustion processes. PM<sub>2.5</sub> is considered to be more hazardous to human health than PM<sub>10</sub>.

The average NO<sub>2</sub> concentration in Kabul air was 305 µg/m<sup>3</sup> (1 hour). which exceeded the WHO recommended limit 200 µg/m<sup>3</sup> (1 hour). NO<sub>2</sub> is produced by electric generators, combustion processes, but primarily from the vehicular exhaust. NO<sub>2</sub> level is higher in urban areas due to vehicle traffic. In addition, it is an important ingredient in the generation of smog which spreads in most areas of Kabul and has harmful effects such as damage to the upper respiratory system and lungs.

The average SO<sub>2</sub> concentration in Kabul air was 75 µg/m<sup>3</sup> (24 hour). which exceeded the WHO recommended limit 20 µg/m<sup>3</sup> (24 hour). it shows four time higher then WHO recommended. Factors like an increase in population growth and the number of vehicles are responsible for raising the SO<sub>2</sub> levels.

The average O<sub>3</sub> concentration in Kabul air was 54 µg/m<sup>3</sup> (8 hour). which exceeded the WHO recommended limit 100 µg/m<sup>3</sup> (8 hour). The main sources of O<sub>3</sub> pollution in Kabul are old and smoky cars (cars with

expired use date in country of origin and imported to Afghanistan) and power generators. An analysis of NEPA data indicates that the amount of O<sub>3</sub> in Kabul has increased by 20% since 2015.

The average CO concentration in Kabul air was 18 µg/m<sup>3</sup> (1 hour). which exceeded the WHO recommended limit 30 µg/m<sup>3</sup> (1 hour). the main source is vehicular emissions, particularly from diesel vehicles, burning coal and wood, thermal generators, and residential combustion processes.

## 1.2. Water Pollution of Kabul City

Several factors threaten Kabul's water supply, including over abstraction of surface and groundwater and pollution by sewage. [12] The water overuse is partly due to poor management and Deforestation due to poverty, and instability in Afghanistan. Recent years have seen shallow wells being installed and financed by aid programs, but with a high population growth rate, groundwater has also been over utilized. Around 85% of residents obtain their water from groundwater, mainly from shallow aquifers, which is obtained by hand pumps. The status of groundwater shows that groundwater levels are declining quickly (1.8 m/year) from 2003 up to 2020 and several wells are already dry in fig.2. Moreover, water quality analyses of the Kabul aquifers show a negative trend in groundwater quality in respect to concentration of nitrates, borates and faecal microbes (indicated by the coliform bacteria). **Table:2** shows Physical and Biological

Assessment of the Kabul city Groundwater.it shows water quality it higher then WHO water quality index.

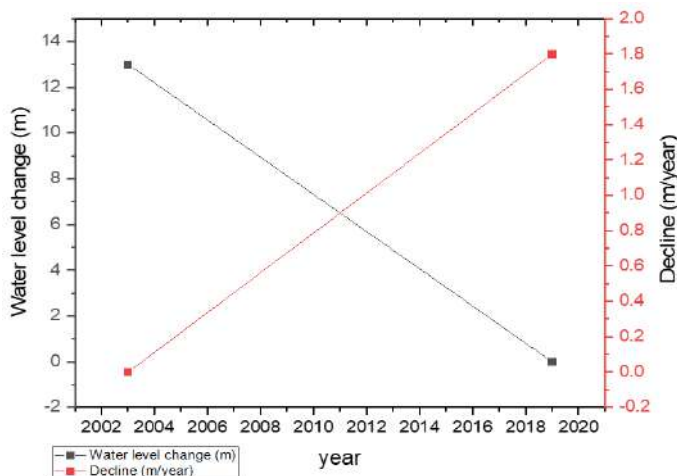


Fig.2. Availability of drinking water resources between 2003-2020. [13,14,6]

Table 2: water quality index par year (WHO, UNICEF [15,16,17]).

Parameter	Afghan National Authority Standard(ANSA)	WHO Standard	Kabul water qualityH/L/Average
pH	6.5–8.5	6.5–8.5	8.4/6.8/8.2
TDS(mg/l)	1000	500	1940/360/830
TH	500	500	580/290/385
Turbidity	5NTU	5–25	0.48/24/12
Calcium(mg/l)	75	75	140/22/102
Sulfate(mg/l)	250	250	224/18/103
Sodium(mg/l)	200	200	149/19/83
Magnesium(mg/l)	30	50	100/17/64
Fluoride(mg/l)	<1.5	1.5	0.2/202/1.1
Nitrate(mg/l)	50	10	12/63/37
EC(μS/cm)	1500	1500	3900/1200/2700
Potassium(mg/l)	.	12	17/3/9.7
Iron(mg/l)	0.3	0.1	0.9/0.06/0.1

### 1.3. Soil Pollution of Kabul City

Land degradation in Kabul is the result of xenobiotic (human-made) chemicals and other changes in the natural soil environment, such as soil contamination. Land contamination in Kabul is primarily due to industrial activity, agricultural chemicals or improper waste disposal. Petroleum hydrocarbons, polynuclear aromatic hydrocarbons (such as naphthalene and benzo), solvents, pesticides, lead, and other heavy metals are the most common chemicals used during the manufacturing process.

Contamination is correlated with the degree of industrialization and intensity of chemical substance. The concern over soil contamination stems primarily from health risks, from direct contact with the contaminated soil, vapor from the contaminants, or from secondary contamination of water supplies within and underlying the soil.<sup>[17]</sup>

### 1.4. Kabul Swage and Solid Waste Management

In detail, a review of the current situation shows that waste management in Kabul is not appropriate and there

are a number of challenges within the system. Most of them do not know how to separate and recycle hazardous waste. In Kabul, municipal solid waste management has been neglected by the government and the general public. Solid waste generation and improper management have had a huge impact on Kabul city. Over 4 million people live in the city of which 3,050 tons of solid waste are generated each day, however only 1800 tons was collected for disposal. Some of these substances have been accumulating, damaging public health and the environment, according to Kabul Municipality. In Kabul, there is no modern waste disposal facility. In the city, there are no proper collection, transportation, and incineration facilities. There are many challenges associated with domestic waste as well as hospital waste and hazardous waste. There are no controls on the burn process, so toxic gases are released, which can lead to various problems. In table3, you can see the amount of waste produced by Kabul in 2018. With a rapidly growing population, Kabul faces infrastructure challenges. [19] wastewater management is one of the biggest problems. Most of Kabul does not have this infrastructure, allowing waste and potable groundwater to mix, leading to the smell of stench causing health risks for the citizens.in **fig .3** is show the solid waste produce par day in Kabul city in 2018.

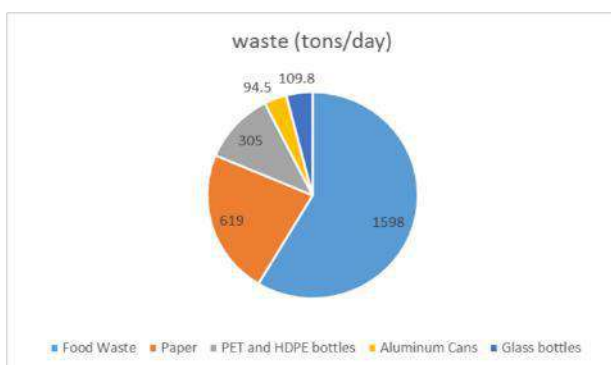


Fig 3: solid waste producing tons/par in Kabul.



Fig 4. a and b show the Kol Heshmat khan before and c is the after degradation Kol Heshmat khan.

### 1.5. Degradation of Protected Kabul Areas

The Heshmat Khan Park is a protected area and national park in Kabul, Afghanistan.<sup>[20]</sup>In June 2017, the Ministry of Agriculture, Irrigation and Livestock named Kol Heshmat Khan the fourth national park on the occasion of World Day. Kol Heshmat Khan covers an area of 191 hectares and is located at the base of Shirdaravazeh and Bala Hesar mountains, southwest of Kabul. Waterfowl have nested at this col since the past, and the area has been a hunting ground for kings in the past. It is estimated that about 30,000 migratory birds and waterfowl, all related to 157 species, hatched at this col in 1980. Using both nutrition and bathing. In a large part of the Kol Heshmat Khan land, land grabbers had already occupied land. By placing booths and car washes in this area, and building roads, this land had lost its natural beauty and created environmental problems for this ecosystem. Kol Heshmat Khan suffered from everything from pollution of the Logar Sea to domestic animal grazing, cutting of reeds, brutal bird hunting, irrigation, and finally laundry before the recent civil war. From 1979 onwards, the Kol Heshmat Khan area was closed for security reasons. The birds that were present in this area in 1370 were threatened with cruel and reckless hunting and most of them escaped. Cole itself was used for irresponsible interventions and more water was used for irrigation. In recent years, these threats have taken on a different form, with more areas being illegally owned by individuals and turned into residential areas. **Fig 4(a&b, c)** it's shows the changes of Kol Heshmat Khan.

## 2. Important Factors in Environmental Degradation in Kabul

### 2.1. High Urban Kabul Population

The population of Kabul has grown since the new administration and the US invasion of Afghanistan in 2001, and the intensity of the war in other Afghan provinces and the relative security in Kabul as well as health care, good education and Business, from Different parts of Afghanistan migrated to Kabul, also return of migrants from Pakistan and Iran and the relocation of the majority in Kabul intensified this process. As shown in Fig 5, Kabul Afghanistan's population level and growth rate between 1950 and 2022. <sup>[22]</sup> UN population projections for 2034 are also included. From 2001 to 2021, the population has grown by about 60%. With increasing population, it has destructive effects on the environment. The city with its old master plan only has a maximum capacity of one million people, but now the existing figure is four times more than the standard capacity of the city. The main environmental problems in Kabul are from the environmental point of view is Most of the agricultural land and deforestation became housing for shops and roads, which in addition to beautifying the environment, helped land to absorb water, regulate the climate, and protect the land from soil dispersion also responsible for absorbing greenhouse gases and producing oxygen, in which case rainwater and snow are not absorbed by the ground, groundwater is reduced, greenhouse gases are increased, and soil erosion is increased. Increased population Water consumption also increased The city of Kabul is using 100 million cubic meters of underground water every year, which re-feeds about 60 million cubic meters of water to underground sources from the rains, and as a result, we have a reduction of 40 million cubic meters of water in the balance every year. groundwater in some parts of Kabul has been reduced to ten meters due to excessive consumption. the average groundwater depletion in Kabul was 15 meters, with Khairkhaneh facing a 45-meter decrease in groundwater, with more water shortages with the increase in population, energy consumption, waste materials, wastewater were also increased About 3,050 tons of garbage is produced daily in Kabul, and the municipality of this city has the ability to move 1,800 tons of this garbage out of the city. There are 800,000 cars in Kabul. The fuel of these cars is the main cause of air pollution because the fuel is not standard and is of poor quality. the increase in the population of Kabul is one of the main reasons for the environment of Kabul.

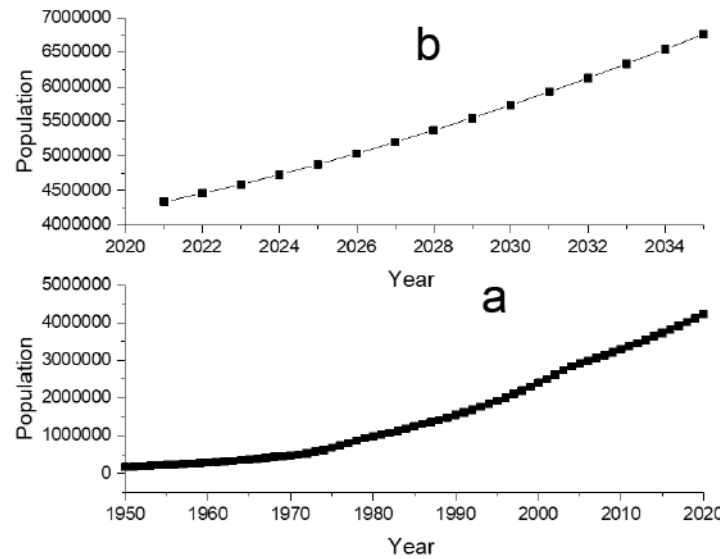


Fig 5: a shows the population growth between 1950-2020, b show population growth rate between 2020-2034.

### 2.2. Poverty

Kabul province is located in the east of the country and the center of Kabul is its center. Kabul Province has a population of more than four million. Kabul is located in a valley surrounded by mountains and at the intersection of trade routes from north to south and east to west. Therefore, Kabul province is the economic and political center of the country. At the district level, poverty outcomes show some differences in poverty rates in Kabul. The poverty rate in the districts of Kabul province varies from 29.2 to 87.6 percent. Kabul is the most populous province of Afghanistan. The province alone makes up 13 percent of Afghanistan's population and 10 percent of Afghanistan's poor. A large proportion of the country's poor is in Kabul. Given the relatively high poverty rate of 34.6% and the very large population size in central Kabul, the absolute size of the poor population is large.<sup>[23]</sup> In central Kabul, despite the majority of the poor living in central Kabul, Poverty and environmental degradation are directly related. As poverty increases, so does environmental degradation, and this relationship operates in a cycle. The dependence of poverty on the fact that the livelihood of the majority of people depends on natural resources; Lack of access to healthy goods and energy and a clean environment play an important role in the destruction of vegetation and wildlife. Trees, by producing oxygen and absorbing carbon dioxide from the air, also play a major role in the air, providing rainfall, preventing soil erosion, and protecting plant and animal species. Due to the poverty cutting of trees in Kabul create the deadliest to the environment. Not only trees but also plastic coal of

motor beams are used for cooking and heating of houses, which has caused gas production and air pollution. Due to poverty, people use the non-mechanized system of agriculture, which causes more water consumption, and the use of fertilizers causes water pollution and excessive water consumption.

### 2.3. Environmental Degradation due to War in Kabul

Since 1964, Afghanistan is under continuous conflict. The history of contemporary war can be traced back to 1979 when Afghanistan was occupied by the former USSR. The attack on the World Trade towers brought more miseries in terms of US attacks. Due to continuous engagements in war, care about environmental protection and resource conservation was less. This has got bad impacts on water and forest resources. The present forest cover has been decreasing up to 2% against the international standard of 25%. Before 1970, eight hydropower plants were functional and were irrigating 118500 hectares of land. With the passage of time, there was a decrease and Afghanistan could not continue the same progress. Now Afghanistan has planned 12 dams on the Kabul River system. Due to huge water extraction, this may bring another ecological disturbance in Afghanistan as well as in the neighboring countries. <sup>[24]</sup>The war has directly and indirectly created environmental problems in Afghanistan, especially in Kabul. The lack of business has led to poverty, which in turn causes environmental problems. Chemical weapons have been used during the war in Afghanistan, causing severe short-term damage to Afghanistan's environment and ecosystem. There is no data on their long-term effects. Migration: is another problem (both inside and outside Afghanistan migration) associated with war. It has also a negative impact on the environment. On one hand, there is a burden on the resource-base of the area, on the other hand, they leave resource/s unattended and unused. In this way balance between resource distribution, availability, and use is disturbed, ultimately affecting the environment in terms of resource loss and waste production.



Fig6: effect of war on environment in AFG <sup>[25]</sup>

### 2.4. The Unhealthy Management Urban Planning System

unhealthy management and lack of attention of the environmental government One of the problems of Afghanistan's environment, especially in Kabul, environmental problems in different parts such as solid waste management not only affect human health and economy also Kabul looks like a bad landscape. Lack of proper landfills and lack of recycling system has a high impact on water and the economy. Lack of wastewater treatment system results in polluted water. lack of attention of the government on environmental awareness programs. Incomplete traffic system. Lack of master Urban plan as a result of unplanned houses in Kabul. Non-implementation of environmental laws. for reducing environmental problems need a strong Environmental Strategy The goal of the National Environmental Strategy is to improve the quality of life of the Afghan people through the protection, maintenance, and improvement of the country's environment. This strategy uses a coherent approach to providing guidelines to include environmental issues and policies in Afghanistan's development priorities, in order to help the country's growing economy and reduce poverty. As a result of implementing the national environmental strategy, the following goals should be achieved, providing a clean and healthy environment for the people of Afghanistan Achieving sustainable economic and social growth while preserving the country's natural resources and environment Ensuring effective management of the country's environment through the participation of all interested departments One of the environmental problems of Afghanistan, especially the city of Kabul. the main reason of unhealthy management and lack of attention of the environmental government are Prolonged wars and widespread corruption in institutions and the lack of global attention to environmental protection in Afghanistan.

### 2.5. Natural impact on urban environmental resources

natural events including floods, droughts, and windstorms in urban is worth mentioning that floods occurring as a result of poor planning and non-adherence to planning requirements are more human-induced than natural event.

### 3. the impact of Kabul's environmental pollution on economics and health

pollution direct and indirect impact not only on the Human health also impact on the economy. Thousands of people die every year due to air and water pollution, tens of thousands of people get sick and infections by pollution, treating the highest drug consumption. Air pollution caused 51,600 deaths in Afghanistan in 2016, according to a report from the Health Effects Institute's State of Global

Air project. The country's air pollution is among the worst in the world, killing 406 people per 100,000 people every year. Data on PM<sub>2.5</sub>, ozone, and indoor air pollution caused by solid fuel combustion are combined in this report. [26] The weather and geography influence air circulation in Kabul, which is exacerbated by high levels of manmade emissions. Fuels such as leaded gasoline and poor quality fuels are used in vehicles and domestic generators, light industrial plants, and waste, plastics, coal, and rubber is burned. A combination of rapid population growth and insufficient urban planning, as well as the lack of available green spaces in Kabul are also contributing factors. In the winter, when residents rely on wood and coal for heating, the problem is particularly acute. Several studies have shown that air pollution affects education and economic income, the New York Times reported. An individual's performance at school, university, or at work is impaired when they are in a bad mood. Depressed individuals are less productive. If, however, a person's performance at school and at work is affected by health problems, then the threat is long-lasting and has a detrimental effect on educational and economic productivity." On the other hand, greater air pollution has been a major challenge for the entire world in recent years. Not only does this challenge affect the health and lives of individuals, but also the world economy as it destroys 225 billion dollars a year. The most affected countries are those in South Asia. An OECD study has found that air pollution costs the world economy billions of dollars in lost revenue each year, and that number will be multiplied by 2060 as air pollution increases. The organization writes that air pollution affects human health and agriculture. In addition, it has a variety of other effects. Many of these effects will be seen more widely in the coming years. An increase in economic activity and energy demand will cause air pollution to rise sharply. Emissions of ozone and PM<sub>2.5</sub> have been detrimental to the economy in recent years. Air pollution will cost 176 billion dollars in 2060, up from 21 billion dollars in 2015. Globally, air pollution will also cause 3.7 billion lost working days in 2060, which directly impacts labor productivity. The estimated cost of air pollution is billions of dollars. Pollution of water is an unpleasant and unfavorable situation that has many negative effects and is hazardous to both living organisms and the economy, as well as causing many kinds of diseases among the general population. The health effects of water pollution vary depending on how long they last and how short they last. It is believed that the substances that enter the body through water pollution destroy a variety of tissues and are responsible for causing a wide variety of diseases in human beings. Having to dispose of waste as quickly as possible is crucial when it is

contaminated. In recent years, environmentalists have described waste as dirty gold from an economic point of view. This implies that waste can play a crucial role in the national economic cycle of countries as a source of income and employment. There are several countries in Asia, including China, that have large waste recycling plants that recycle waste, providing raw materials to other production units whose products are sold internationally. Thousands of items may be made from waste, such as shoes, paper, foil, and thousands of other things with efficient management and recycling systems. Solid waste disposal which is not based on scientific principles puts at risk the population in areas without proper waste disposal methods, especially pre-Scholar's; waste workers or workers in facilities that produce toxic and infectious materials. A high-risk population may also include those living close to waste dumping sites and those whose drinking water has become contaminated as a result of waste dumping or leakage from landfill sites. An increase in infection and injury is also associated with uncollected solid waste. Children are more susceptible to health effects resulting from hazardous waste exposure. By the very act of releasing chemical waste into the environment, direct exposure to chemicals can lead to diseases. Toxic chemicals can be found in the environment. The disappearance of protected areas has a direct impact on the country's economy. In the past, thousands of people came every year to see the beautiful area of Kol Heshmat Khan, because Kol Heshmat Khan was an area for migratory and native birds and was a beautiful and natural sight. In general, pollution has a direct impact on the economy and health of the people of Kabul. The relationship between economy and health is directly related to pollution. The lower the pollution, the higher the economy of the people and the healthier the people and reflect.

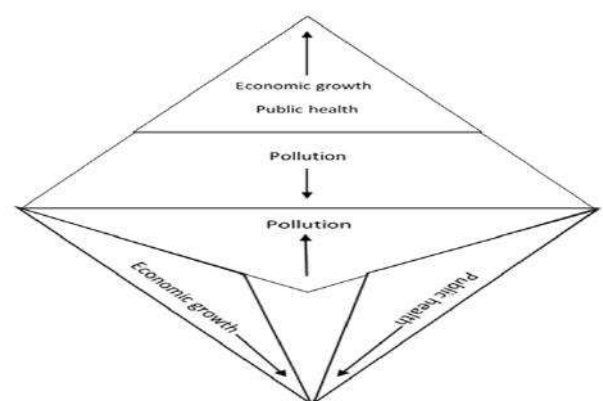


Fig7: relationship between economic/health and pollution.

## V. CONCLUSION



After analyzing the data, Kabul city has problems such as soil erosion, protected area degradation, water pollution, air pollution, solid waste and wastewater management, which not only caused various diseases and deaths, but also severe damage to the economy of the country and people. The main causes of these environmental problems are population growth, poverty, long wars, lack of government attention and unhealthy environmental management. Kabul was built according to the master plan for one million people, but its current population is more than four million. Kabul is one of the most polluted cities in the world. The ongoing wars of the last half century have caused the government to pay no attention to the environment and the effects of the chemicals used during the wars have not been addressed. Poverty has led people to cut down trees for cooking and heating, or to use plastic and coal, which has destroyed green buildings and increased air pollution. Corruption in government offices and the lack of attention of the government and the people is another major cause of environmental problems in Kabul. Environmental problems can be curbed with a sound national strategy and management, international cooperation and raising public awareness.

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## Educational technology to guide self-care for elderly patients at hospital discharge to the home: An integrative review

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**Keywords—** Educational technology, Self-care, Elderly, Patient discharge.

**Abstract—** Objective: To identify in the scientific literature the educational technologies used in self-care guidance for elderly patients at home discharge. Method: An integrative literature review study, whose inclusion criteria were: articles in Portuguese, English and Spanish, articles in full that portrayed the theme, published in the last five years and available online and free of charge in the databases of data: PubMed, Medline (National Library of Medicine) and LILACS (Latin American Literature in Health Sciences). Results: 12 publications were found, the analysis took place through analytical and interpretive readings and the educational technologies used were varied. Conclusion: It is noticed that the use of the booklet as an educational technology was the most used in the studies, and also, the limitation of the studies in directing and restricting the care orientation in only one specific approach for each clinical case presented by the patient.

### I. INTRODUCTION

Technologies are structured as a set of knowledge related to products and materials that define therapies and work processes and constitute instruments that help health actions. When these are educational, they mediate the teaching and learning processes. [1]

Health education is a tool used to trigger health promotion, prevention and recovery actions. [2]

Technologies combined with health education offer the necessary support for the discussion for the self-care of elderly patients with hospital discharge planning, since it offers knowledge and empowerment of their capacities in order to understand their basic human needs.

Self-care can be conceptualized as a guided action taken by the individual in order to regulate the factors that affect their own development, performing activities that promote their well-being and life, involving

spiritual, physical, mental and social aspects, providing quality of life. [3]

For Galvão and Janeiro self-care is a regulatory function that allows people to perform, by themselves, activities aimed at preserving life, health, development and well-being. [4]

Self-care is considered an integral component of managing chronic diseases and preserving an acceptable level of functionality. It allows the person to observe himself, recognize symptoms, determine the aggressiveness of the symptomatology and choose appropriate strategies to overcome these symptoms, minimizing them and maximizing health. Thus, self-care integrates not only the ability to take care of oneself, but also the performance of essential activities to achieve, maintain or promote optimal health. [4]

The capacity for self-care is only affirmed when the individual is able to perform the self-care activity to maintain, restore or improve their health and well-being. In the studies by Santos, Ramos and Fonseca [5] it was observed that all human beings are willing to take care of themselves and their dependent family members. They have the potential and the ability to learn to meet their self-care needs.

Self-care emerges as the promotion of activities promoted by the personal care demanded daily to regulate its own functioning and development. While the self-care deficit is related to the commitment to its accomplishment. [6]

The period after hospital discharge is a time of challenges for patients and family members, as they find difficulties in carrying out daily activities and doubts about self-care management. [7]

The transition of care from the hospital environment to the home is an important strategy to avoid hospital readmissions, as it contributes to the coordination and continuity of care, minimizing adverse events and other post-discharge complications. Actions taken include discharge planning, health education, promotion of self-management of care, guidance on medication and articulation with the health network. [7]

The modifications of senescence and senility affect self-care actions. Thus, the elderly, especially those hospitalized, need adequate multidisciplinary guidance to strengthen their autonomy. [8-9]

In view of this process of welcoming, caring and educating, the planning of hospital discharge at home is essential to ensure the continuation and quality of care (7). Since discharge can generate an ambiguous feeling for the patient, family members and caregivers, as there

is a mixture of feelings of happiness and insecurity. [10]

Souza et al. reports that the elderly are the main users of health services and have a higher frequency of hospital admissions, as well as a longer length of stay. They use hospital services more intensively than other age groups, involving high costs, implying a longer duration of treatment and slower and more complicated recovery. [11]

A large part of the elderly, after discharge, present some degree of limitation and family members are often not prepared to face this situation, making State support to family members essential. [12]

Aging associated with dependency leads to the need to replace some self-care, which is normally undertaken by a family member. This role involves multiple responsibilities that can cause overload when the needs of this family member are not met. [13]

In view of the above, the number of the elderly population in Brazil has been growing at an accelerated rate. According to the Brazilian Institute of Geography and Statistics (IBGE), [14] it is estimated that the population aged 60 and over is 30 million people, representing about 14% of the general population (210 million inhabitants), and it is still the population segment with the highest growth rate - above 4% per year - from 14.2 million in 2000 to 19.6 million in 2010, and should reach 41.5 million in 2030 and 73.5 million, in 2060.

However, this accelerated aging of the Brazilian population should not necessarily be considered a problem, but requires attention and brings important challenges for society. In the elderly, chronic health conditions are more prevalent, requiring responses capable not only of solving these problems, but of maintaining or recovering their autonomy and independence, with quality, resolution and cost-effectiveness. [15]

As it ages, the population starts to present a differentiated epidemiological profile, characterized by the progressive increase in the prevalence of non-communicable chronic diseases, such as diabetes, coronary artery disease and obstructive pulmonary disease, among others, which leads to the growing demand for health care long duration. [16]

However, the population does not age in the same way: there are elderly people who remain absolutely capable of carrying out their daily activities by themselves, even if they have chronic diseases or other important health conditions. Other people need support and adaptations to carry out their activities and some become completely dependent on continuous care and

the help of others, even if they are not chronologically that old. Thus, the presence of multiple health problems and advanced age does not necessarily imply dependence to perform activities of daily living or functional dependence. [17]

The initial motivation for this research came during the professional practice in the medical clinic service of Fundação Santa Casa de Misericórdia do Pará (FSCMPa). The medical clinic sector of that institution is characterized by the continuous service to users, mostly elderly, with the presence of comorbidities and non-communicable chronic degenerative diseases, a fact that corroborates the emergence of doubts and difficulties of patients and families for the care to be applied in the most diverse areas of health.

Restlessness and concern arise in the professional / researcher from the moment he starts to hear reports from patients, caregivers and/or family members about difficulties in adapting to routine, health monitoring, doubts and insecurities regarding post-hospital self-care.

Hospital discharge planning with an emphasis on self-care for elderly patients is a complex aspect of care. However, through the care practice in the medical clinic, it was possible to observe that these actions have not been prioritized and documented among the activities that are under the responsibility of the nurse. It is also a topic that is rarely addressed by undergraduate and/or postgraduate nursing students.

Furthermore, the clinical care practice of the nursing professional in the medical clinic service is overloaded, due to multiple administrative functions and the large number of care services performed routinely on duty, a fact that corroborates the emergence of flaws in the education planning process for the self-care of the patient still hospitalized and also at the time of hospital discharge.

In this way, family members and patients end up not receiving the necessary attention to suppress their inquiries and doubts. Also, given this scenario, the institution does not have a study on the subject and a formal instrument that facilitates or assists the professional, family members and patient in this process of monitoring, guidance and planning of hospital discharge to home.

For Delatorre et al. [9] during hospitalizations, patients and caregivers need to receive adequate guidance in order to limit disabilities, damages, avoid subsequent hospitalizations and ensure quality of life.

Thus, this study aims to identify in the scientific literature the educational technologies used in self-care guidance for elderly patients at hospital discharge home.

## II. METHOD

This is a bibliographic study with a quantitative approach of the integrative literature review type and followed the following steps: elaboration of the research question, definition of databases and criteria for inclusion and exclusion of studies, definition of information to be extracted from studies selected, evaluation of the studies included in the review, presentation and discussion of the results and presentation of the review.

The guiding question was: What educational technologies have been used to guide the self-care of elderly patients at hospital discharge home? To select the articles, free online access was used in the following databases: PubMed, Medline (National Library of Medicine) and LILACS (Latin American Literature in Health Sciences).

The search for articles took place between September and October 2020 using the following controlled descriptors and their combinations in English and Portuguese: Educational technology (Educational technology), self-care, elderly (aged) and patient discharge (patient discharge), mediated by the Boolean operator "AND", aiming to expand the number of studies. The descriptors were extracted from the DECS (Descriptors in Health Sciences) and from the MESH (Medical Subject Headings) of the National Library.

The inclusion criteria of the studies were: articles in Portuguese, English and Spanish, articles in full that portrayed the theme and published in the last five years. The following were excluded: editorials, letters to the editor, reflective studies, as well as studies that did not address the topic relevant to the objective of the study, studies that did not fully present the pre-defined information to be extracted and literature reviews.

For analysis and synthesis of the selected articles, a structured form was used, filled in for each article in the final sample, containing the following information: Identification of the article (author, type and year of publication), title, search location, type of research, educational technology and descriptors.

A total of 984 scientific articles were found in the databases. However, the final sample consisted of 39 publications, which met the established criteria. However, after analytical reading of these studies, only 12 publications were used as object of study. The articles

were excluded because they did not answer the guiding question of this study, were repeated, were not available in full, and did not clearly present the proposed educational technology. The results were presented by means of charts and tables and discussed according to the relevant literature.

### III. RESULTS

Table 1 presents, in a general and comprehensive way, the pre-selected information for the study and extracted from the researched articles, of which 11 were identified in the LILACS database (Latin American Literature in Health Sciences) and 01 in PubMed / Medline. As for publication, eight were published in nursing journals and two in

journals in other health areas. Table 1 shows the methodology applied in the studies, 04 (33.3%) articles were classified as action research, 04 (33.3%) as methodological research, 02 (16.6%) as convergent care research, 01(8) .3%) as qualitative research and 01 (8.3%) as a prototyping-type technological production study.

Table 2 presents the type of technology identified in the review studies. Which stand out: educational booklet (05), educational guide (02), educational workshop (01), interactive blog (01), educational mobile application (01), educational video (01), memory game (01), educational banner (01) 01), educational doll (01) and storytelling (01).

*Table 1: Presentation of articles included in the integrative review according to Identification (authors, type and year of publication) title, search location, type of research, educational technology, descriptors and care, Belém, Pará, Brazil, 2021.*

N	Article Identification	Title	Search location	Search type	Educational Technology	Descriptors	Care
1	AGUIAR,A.C. T. et al. Artigo científico 2018	Capacitação do familiar cuidador na adesão à prevenção e ao controle da hipertensão arterial	Rev. Brasileira de Promoção a Saúde (LILACS)	Action research	Educational workshops	Hypertension Health education care	Guidelines for care giverson Systemic Arterial Hypertension
2	GONÇALVES, M.S. et al. Artigo científico 2019	Construção e validação de cartilha educativa para promoção da alimentação saudável entre pacientes diabéticos	Rev. Brasileira de Promoção a Saúde (LILACS)	Methodological research	Educational booklet	Health promotion Educational technology Food Validation studies	Healthy food for diabetic patient
3	CAMACHO, A.C.L.F. et al. Artigo científico 2019	Tecnologia educacional interativa sobre cuidados a idosos com demências	Rev de Enfermagem UFPE online (LILACS)	Descriptive qualitative research type experience report	interactive blog	Elderly health Nursing Educational technology Health education Information Technology	Alzheimer's disease guidance

4	MENDEZ,C.B. et al. Artigo científico 2019	Aplicativo móvel educativo e de followup para pacientes com doença arterial periférica	Revista Latino Americana de Enfermagem (LILACS)	Study of technological production type prototyping	Educational mobile app	Nursing care Educational technology Information Technology peripheral arterial disease	Care in patients with peripheral arterial disease
5	CARDOSO, R.S.S et al. Tese de mestrado 2016	Tecnologia educacional: um instrumento dinamizador do cuidado com idosos	LILACS	Action research with a qualitative approach	Educational guide Educational video	Elderly health Care givers Educational technology	Elderly care for care givers
6	FERREIRA, J.M. et al. Artigo científico 2018	Gerontotecnologia para prevenção de quedas dos idosos com Parkinson	Revista Brasileira de Enfermagem (REBEN) (LILACS)	Convergent research	educational booklet memory game	Educational technology Oldman Health promotion Accident by falls Parkinson's disease.	Care in preventing falls in the elderly
7	PENNAFORT, V.P.S. et al. Artigo científico 2019	Tecnologia educacional para orientação de idosos nos cuidados com a fístula arteriovenosa	Revista Enfermagem em Foco (LILACS)	Action research	educational banner educational doll	Educational technology Elderly Nursing care Renal dialysis Arteriovenous fistula	Arteriovenous fistula care
8	CARVALHO, D.S. et al. Artigo científico 2017	Construção de tecnologia educacional para estomizados: enfoque no cuidado da pele periestoma	Revista Brasileira de Enfermagem (REBEN) (LILACS)	Action research with a qualitative approach	Orientation guide	Educational technology Health education Nursing ostomy focus group	Peristomy skin care
9	SENA, J.F. et al. Artigo científico 2020	Validação de material educativo para o cuidado da pessoa com estomia intestinal	Revista Latino Americana de Enfermagem	Methodological research	Educational booklet	Educational technology Nursing care Self care Stoma health education	Stoma care

			(LILACS)			Validation studies	
10	ALVES, A.M Tese de mestrado 2017	Construção e validação de cartilha educativa para prevenção de quedas em idosos	LILACS	Methodological research	Educational booklet	Educational technology health promotion Acidentes due to falls Elderly health	Guidance for preventing acidentes from falls in the elderly
11	GALDINO, Y.L.S. et al. Artigo cientifico 2019	Validação de cartilha sobre autocuidado com pés de pessoas com diabetes mellitus	Revista Brasileira de Enfermagem (REBEN) (LILACS)	Methodological research	Educational booklet	Educational technology Validation studies Diabetic foot diabetes mellitus	Diabetic foot care
12	COSTA, N.P et al. Artigo cientifico 2016	Contação de história: tecnologia cuidativa na educação permanente para o envelhecimento ativo	Revista Brasileira de Enfermagem (REBEN) (PUB MED)	Convergent care research	Educational care storytelling	Educational technology Health education activeaging geriatric nursing	Self care in aging

Source: Bibliographic search of the authors, 2021.

Table 2: Distribution of research types identified in integrative review studies, Belém, Pará, Brazil, 2021.

Search type	N	%
Action Search	04	33,3
Methodological Research	04	33,3
Qualitative research	01	8,3
Study of technological production type prototyping	01	8,3
Convergent care research	02	16,6

Source: Bibliographic search of the authors, 2021.



Table 3: Distribution of educational technologies identified in integrative review studies, Belém, Pará, Brazil, 2021.

Educational technologies	N
Educational workshops	01
Educational booklet	05
Interactive blog	01
Educational mobile app	01
Educational guide	02
Educational video	01
Memory game	01
Educational banner	01
Educational doll	01
Storytelling	01

Source: Bibliographic search of the authors, 2021.

#### IV. DISCUSSION

Most of the documented research was based on scientific articles, which comprise strategies that facilitate access to knowledge by researchers through publications on free platforms such as electronic journals indexed in the investigated databases.

Nursing was the area of knowledge where all publications were concentrated. Care for the human being is the basis of nursing science, which has sought over the years to solidify knowledge through the practice of scientific research. For Galvão and Janeiro [4] promoting and maintaining self-care in people with chronic disease is a central role of nurses' intervention, as their interaction is constant in any context – hospitals, health centers, outpatient clinics, continued care and in the community. The implementation of self-care actions promotes a partnership between nurses and the person/family, so that the latter develop skills and knowledge to adapt and make informed decisions regarding their chronic illness.

From the admission of the elderly-family caregiver to discharge, it is essential that the nurse is able to assess and diagnose the needs of the dependent elderly person, the family, the caregiver and the home environment through a care plan developed by an interdisciplinary team that includes guidance to the caregiver, enabling him to provide care adequately. [18]

The elaboration of the booklet was evidenced as the main educational technology in the research used. A booklet is an educational material that enables patients to better understand the health problem they are experiencing, helping them to reflect on their lifestyle and to develop the capacity for autonomy in health care. [19]

It is believed that the largest number for this educational technology to be used is because it is creative and attractive and disseminates information quickly, in addition to enabling the achievement of patients' goals, favoring the optimization of nursing work.

For Torres et al. [17] the use of educational materials contributes to the improvement of the level of knowledge, development of skills and greater autonomy of the person, being able to allow the subjects to reflect on behavior and actions that influence their health pattern.

Despite all the scientific and technological development in recent years, the use of informative booklets as efficient educational strategies to be used with the elderly stood out in the literature. For Camacho et al. [19] the activities developed through these educational technologies sought to provide health education based on actions that recognize the true needs, desires and aspirations of the assisted individuals.

As for the type of research, action research and methodological research stood out. Action research is a type of applied research in the field of Social Sciences, meaning a simultaneous process of investigation and action, whose primary intention is the knowledge and resolution of the collective problem from the observed facts, culminating in the transformation of researchers and participants involved in the social context, site of the problem. However, it has been increasing in health research, especially with regard to the human care process, and can be seen in preventive medicine, occupational medicine and in the field of mental health, as well as in the various spaces of the professional practice of nurses. [20]

The use of the most used descriptors was

educational technology, health education, nursing and elderly.

It was observed the concentration of studies in a particular care only for the orientation of the patient, with no studies found with a holistic assessment of post-discharge care and its subsequent dissemination, since the elderly patient usually admits several clinical conditions, therefore, it is assumed the need for guidance on at least more than one care.

In the studies by Souza et al. [11] the main diagnoses found in hospitalized patients were separated by systems, with a great emphasis on diseases related to the respiratory and neurological systems, and alterations in the skeletal and digestive systems. But this is not only true in relation to diseases that affect the locomotor system, but also very prevalent systemic diseases, such as heart failure, pneumonia and dementia, which manifest with loss of function in the elderly. As for the main reasons for hospitalization, most of the findings involved pulmonary disorders. This occurrence is due to their greater physiological and immunological susceptibility to infections, contributing to the reduction of physical and biological capacity and decreasing their autonomy. In addition to the high prevalence of chronic-degenerative diseases associated with aging, conditions with different etiologies are more severely expressed in the elderly.

## V. CONCLUSION

In this study, the importance of documentation and dissemination of research produced and indexed in scientific articles, the centralization of the self-care theme in the area of nursing concentration, the use of action and methodological research, as well as the limitation of studies in directing and restricting care guidance to only a specific approach for each clinical case presented by the patient.

Nurses play an important role in planning the hospital discharge of elderly patients, as well as being responsible for self-care guidelines for the home practices of patients and their post-discharge family members. It is essential to start the process of self-care guidelines during hospitalization, in order to provide safety and humanized treatment to patients and families.

There is an urgent need for studies and new educational technologies that seek to cover the greatest possible amount of self-care guidelines for elderly patients after hospital discharge, since most elderly people have several vulnerabilities in relation to their health, whether these come from factors of the pathology itself, as well as natural physiological conditions.

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## Self-reported oral health of a quilombola population in the semi-arid region of Piauí

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**Keywords—** *Collective Health; Dental conditions; Quilombola population.*

**Abstract—** *The needy epidemiology of oral health in quilombola populations has been demonstrated by different researches, with the intention that studies be carried in order to identify and determine situations that are liable to be resolved through the help of social and health policies. Objective. To know the perception of oral health regarding oral discomfort and to compare it with general health in a quilombola population in the semi-arid region of Piauí. Methodology. Cross-sectional, descriptive and analytical study. From the adult and elderly population, a sample was calculated considering a margin of error of 5% and 90% of reliability, obtaining a total of 120 people as a minimum sample. Results. Inhabitants of the Canabrava, Tronco and Custaneiras quilombola communities participated - whose age ranged from 21 to 81 years old,  $SD \pm 16.0$ . There is a predominance of: married (67.5%), female (60.8%) small farmers (90%), non-retired (71.7%), income of up to 01 (one) minimum wage (58.3%), and incomplete primary school (42.5%). Oral discomfort had a higher percentage due to the variable -Feels dry mouth (30.8%). There was a significant association ( $p = 0.031$ ) between the perception of general health (excellent, reasonable and poor) and having oral health problems. Conclusion. The association between the perception of general health and having oral health problems reinforces the fact that the poor condition of oral health*

*denotes a close relationship with the living conditions of this society, whether assisted or not by the government.*

## I. INTRODUCTION

Race is a limiting factor in the use of dental services, given that a study, even after adjustments, shows that black people remain with greater difficulty in using oral health services[1].

In order to mitigate inequalities in the racial context, Brazil, by Law no. 12,288, of July 20, 2010, established the Racial Equality Statute. In it, the black population is defined as the group of people who declare themselves to be black and brown, according to the color or race issue, used by the Brazilian Institute of Geography and Statistics (IBGE), or who adopt an analogous self-definition. Likewise, it is intended to guarantee to the black population the realization of equal opportunities, the defense of individual, collective and diffuse ethnic rights and the fight against discrimination and other forms of ethnic intolerance[2].

The facts of Brazilian history highlight a trajectory of social conflicts. With the 1988 Constitution, fundamental rights and guarantees were instituted, however, legal certainty, the regulation of law and the bureaucratization of procedures prevent many of these rights from being achieved by those who most need them[3].

Researchers investigated traditional health systems (THS) from three rural communities in Northeast Brazil and three quilombola communities on the southern coast of Brazil, assuming the idea that the resilience of THS and communities are mutually influenced. They identified, however, that the Federal Government's Family Health Program (PSF) is an important public policy introduced in 1990. It provides easy access to Biomedicine in isolated communities, through the establishment of health posts and community health agents. The agents are trained in the places, by the National Health Foundation, to promote health prevention actions and help people to access them[4].

The greater importance is highlighted by the fact that these communities are almost always geographically isolated and with limited access to health care. Therefore, additional research and data collection contribute to the implementation of public health and policies that reduce the vulnerability of these communities and incorporate an expanded concept of health and well-being[5].

The poor epidemiology of oral health in quilombola populations is demonstrated by several studies. Data from two quilombola communities in the State of Bahia show that, in one, 40% of young adults had carious

lesions, and edentulism<sup>6</sup> affected 13.4% of adults. In the other quilombo community, 5% of young adults had carious lesions, and 18% of adults had edentulism[6]. Another study, when estimating the prevalence of tooth extractions in 864 people from quilombola communities, found that tooth extractions were reported by 82.0% of the quilombola, 49.8% with  $\leq 5$  teeth and 32.2% with  $> 5$  teeth extracted.

They also refer to the fact that having had dental caries was associated with a four times greater chance of having teeth extracted<sup>7</sup>. Furthermore, according to findings from a survey in southern Brazil, negative self-perception of oral health was reported by 53.1% of the quilombola surveyed, in which satisfaction with chewing and with oral appearance was related to a higher prevalence of negative perception of oral health[8].

In this perspective, the production of knowledge about social inequities in health denotes a multiplicity of conceptual, theoretical and methodological perspectives, which are reflected in the field of oral health, which gives rise to the need to analyze the main topics related to this field[9].

In order for studies to be carried out in quilombola communities in order to identify and determine situations that can be resolved with the help of social and health policies, the objective was to know the perception of oral health regarding oral discomfort and compare it with general health in a quilombola population in the semi-arid region of Piauí.

## II. METHODOLOGY

This is a cross-sectional, descriptive and analytical study. The referenced population of adults and elderly people was initially determined by all the inhabitants of the three communities, who are aged between 21 and 81 years. The age designation was based on the Children and Adolescents Statute[10] to determine the beginning of adulthood, while the elderly, those aged 60 and over, according to the National Health Policy for the Elderly - PNSPI11.

With the beginning of the pandemic caused by the new coronavirus - covid-19, there was necessary a suspension of data collection. As, however, the census would have 211 inhabitants, a sample of this total was calculated considering a margin of error of 5% and 90% of reliability, obtaining a total of 120 people as a minimum sample amount. Therefore, a representative, but not

random, sample was obtained from the quilombola population referring to the aforementioned locations, giving continuity to the analysis and discussion of the data.

The questionnaire was composed of socio-demographic variables (age, sex, marital status, retirement, income and occupation), perception of general health (excellent, fair and poor) and oral health (oral discomfort).

As for the characteristic of oral health, those referring to oral discomfort were analyzed, according to Saintrain et al.,[12] (2018) such as: Feel dry mouth (yes/no); period (day/night), Difficulty chewing and swallowing food (yes/no); Problems with the taste of food (yes/no); Burning sensation in the mouth (yes/no); Feel pain for no apparent reason (yes/no); Notice swelling in the mouth that makes it difficult to use dentures (yes/no); Change in voice (yes/no); and the number of oral health problems.

Data were collected from November 2019 to February 2020, tabulated and analyzed using the “Statistical Package for Social Science” software – SPSS® version 24.0 IBM® Absolute and relative frequency, mean, standard deviation, minimum and maximum were calculated. The outcome “self-reported general health” was categorized as excellent, fair and poor, and its prevalence was compared with all other variables using the chi-square or Fisher's exact tests. For this, quantitative variables were categorized, and in all inferential procedures a significance level of 5% was adopted.

The research project was submitted to the Research Ethics Council of the University of Fortaleza, having been approved by Opinion No.0. 3,661,826/19. At the beginning of each interview, the Free and Informed Consent Term was read and signed in two copies, one being delivered to the participant and the other to this author.

### III. RESULTS

A total of 120 representatives of the quilombola community participated in the survey. Among the socio-demographic characteristics, there was the participation of three locations - Canabrava, Tronco and Custaneiras – from which the participants' ages ranged from 21 to 81 years, SD ±16.0.

There is a predominance of: married (67.5%), female (60.8%), small farmers (90%), non-retired (71.7%), income of up to 01 (one) minimum wage (58.3%), and incomplete elementary school (42.5%), as shown in Table 1.

Table 1. Socio-demographic characteristics of inhabitants of the quilombola communities who participated in the survey. Picos - Piauí, 2020.

Variables	N	%
<b>Location</b>		
Canabrava	72	60.0
Tronco	33	27.5
Custaneiras	15	12.5
<b>Age Range</b>		
21 to 29	16	13.3
30 to 39	29	24.2
40 to 49	27	22.5
50 to 59	24	20.0
60 or more	24	20.0
<b>Marital status</b>		
Single	20	16.7
Married	81	67.5
Divorced	2	1.7
Widowed	4	3.3
Other	13	10.8
<b>Sex</b>		
Masculine	47	39.2
Feminine	73	60.8
<b>Retired</b>		
Yes	34	28.3
No	86	71.7
<b>Income</b>		
1 MW	70	58.3
From 2 to 5 MW	4	3.3
Bolsa família	36	30.0
Not informed	10	8.3
<b>Occupation</b>		
Farmer	108	90.0
Public server	3	2.5
Self-employed	2	1.7
Other	7	5.8
<b>Scholastic achievement</b>		
None	27	22.5
Elementary Education – incomplete	51	42.5

Elementary Education – complete	10	8.3
High Education – incomplete	11	9.2
High Education – complete	18	15.0
Higher education	3	2.5

Source: Research data

Table 2 shows the frequency distribution related to oral discomfort, represented in a higher percentage by the variable “Feel dry mouth”, with a percentage of 30.8% and expressing greater aggression during the night (62.2%). Sixty-one participants (50.8%) reported that they did not have any “oral health problems”.

Table 2. Self-reporting oral discomfort of residents of quilombola communities. Picos-Piauí, 2020.

Oral discomfort	N	%
<b>Feel dry mouth</b>		
Yes	37	30.8
No	83	69.2
<b>Period (n=37)</b>		
Day	14	37.8
Night	23	62.2
<b>Difficulty chewing and swallowing food</b>		
Yes	14	11.7
No	106	88.3
<b>Problems with the taste of food</b>		
Yes	12	10.0
No	108	90.0
<b>Burning sensation in the mouth</b>		
Yes	12	10.0

Table 3. Self-reported general health, according to oral health problems of quilombo residents. Picos-Piauí, 2020.

Variables Oral Discomfort	Total	General health						Value p
		Excelent		Reasonable		Bad		
		N	%	n	%	n	%	
<b>Feel dry mouth</b>								0.249
Yes	37	7	18.9	24	64.9	6	16.2	
No	83	23	27.7	54	65.1	6	7.2	

No	108	90.0
<b>Feel pain for no apparent reason</b>		
Yes	14	11.7
No	106	88.3
<b>Notice swelling in the mouth that makes it difficult to use dentures</b>		
Yes	6	5.0
No	114	95.0
<b>Change in voice</b>		
Yes	13	10.8
No	107	89.2
<b>Number of oral health problems</b>		
0	61	50.8
1	31	25.8
2 or more	28	23.4

Source: Research data

Table 3 shows the results regarding oral discomfort and its relationship with general health, stratified into excellent, fair and poor...

It appears that the majority rated their health as fair. There was a significant association (p=0.031) between the perception of general health (excellent, fair and poor) and having oral health problems, noting the fact that, of the 61 participants who did not have oral health problems, 31.1% of them considered their general health to be excellent, while those who reported two or more problems, only 7.1% considered their health to be excellent.

For the other variables, there was no statistically significant relationship. It is noteworthy, therefore, that for those who had no difficulty in chewing and swallowing food, 27.4% of them self-rated their health as excellent, while those who had difficulty, only 7.1% reported their health as such. In the same direction, percentage differences were detected for the other variables.

<b>Difficulty chewing and swallowing food</b>								0.172
Yes	14	1	7.1	11	78.6	2	14.3	
No	106	29	27.4	67	63.2	10	9.4	
<b>Problems with the taste of food</b>								0.055
Yes	12	0	0.0	10	83.3	2	16.7	
No	108	30	27.8	68	63.0	10	9.3	
<b>Burning sensation in the mouth</b>								0.182
Yes	12	1	8.3	11	91.7	0	0.0	
No	108	29	26.9	67	62.0	12	11.1	
<b>Feel pain for no apparent reason</b>								0.819
Yes	14	3	21.4	9	64.3	2	14.3	
No	106	27	25.5	69	65.1	10	9.4	
<b>Notice swelling in the mouth that makes it difficult to use dentures</b>								0.657
Yes	6	1	16.7	4	66.7	1	16.7	
No	114	29	25.4	74	64.9	11	9.6	
<b>Change in voice</b>								0.109
Yes	13	1	7.7	12	92.3	0	0.0	
No	107	29	27.1	66	61.7	12	11.2	
<b>Number of oral health problems</b>								0.031
0	61	19	31.1	39	63.9	3	4.9	
1	31	9	29.0	17	54.8	5	16.1	
2 or more	28	2	7.1	22	78.6	4	14.3	

Fisher's Exact Test.

In Table 4, the results indicate that the self-perception of health status in the last year, stratified into better, equal and worse, related to oral discomfort, was not associated with any of the variables. Although, in the findings, a large percentage of the study respondents

reported that in this relationship with oral discomfort their health is the same as it was in the last year, the high percentage in the similarity that health is better and worse must also be considered.

Table 4. Perception of health in the last year, according to oral health problems of residents of quilombola communities. Picos-Piauí, 2020.

Oral discomfort	Total	Health in the last year						Valor p
		Better		Equal		Worse		
		n	%	n	%	n	%	
<b>Feel dry mouth</b>								0.331 <sup>1</sup>
Yes	37	8	21.6	18	48.6	11	29.7	
No	83	24	28.9	44	53.0	15	18.1	
<b>Difficulty chewing and swallowing food</b>								0.753 <sup>2</sup>
Sim	14	4	28.6	6	42.9	4	28.6	
No	106	28	26.4	56	52.8	22	20.8	



<b>Problems with the taste of food</b>								0.368 <sup>2</sup>
Yes	12	4	33.3	4	33.3	4	33.3	
No	108	28	25.9	58	53.7	22	20.4	
<b>Burning sensation in the mouth</b>								0.612 <sup>2</sup>
Yes	12	3	25.0	5	41.7	4	33.3	
No	108	29	26.9	57	52.8	22	20.4	
<b>Feel pain for no apparent reason</b>								0.268 <sup>2</sup>
Yes	14	6	42.9	5	35.7	3	21.4	
No	106	26	24.5	57	53.8	23	21.7	
<b>Notice swelling in the mouth that makes it difficult to use dentures</b>								0.202 <sup>2</sup>
Yes	6	1	16.7	2	33.3	3	50.0	
No	114	31	27.2	60	52.6	23	20.2	
<b>Change in voice</b>								1.000 <sup>2</sup>
Yes	13	3	23.1	7	53.8	3	23.1	
No	107	29	27.1	55	51.4	23	21.5	
<b>Number of oral health problems</b>								0.051 <sup>1</sup>
0	61	16	26.2	38	62.3	7	11.5	
1	31	7	22.6	14	45.2	10	32.3	
2 or more	28	9	32.1	10	35.7	9	32.1	

Chi-square test

#### IV. DISCUSSION

Although oral health is part of general health[13], it is often neglected in this relationship. This reflection on oral discomfort in the quilombola population contributed to the evaluation of their well-being, which is what differs this research from most other studies related to oral health in this part of the population. In this context, researchers emphasize that most of the indicators used to assess oral health status almost always refer to specific clinical studies, such as dental caries, periodontal disease and use or need for dentures. However, when evaluating the relationship between Subjective Well-being - SWB - and self-reported oral discomfort, they reveal that poor oral health leads to physical, psychological and/or social problems that directly interfere with their well-being[12].

Quilombola communities, by their nature, share aspects of vulnerability with other populations established in rural areas and with other black populations in Brazil. Therefore, oral health, in addition to having an intensive relationship with the way a person perceives their health as a whole, is also influenced by beliefs, by the sociodemographic profile, among other circumstances[8].

Regarding the socio-demographic profile, in this study, the greater participation of women is corroborated by

research carried out in this same area and which showed that this was significantly higher when compared to men. This pre-existing predominance is highlighted, and following the trend regarding the sex of people, especially those over sixty years old[14, 15]. However, a higher prevalence of farmers was detected, a difference due, of course, to the lifestyle adopted by men and women in the countryside.

In view of the above, one has to consider the fact that most of the participants earn only a minimum wage, followed by those who support themselves through the contribution of the "Bolsa Família" program. In this context, it is important to understand how social inequalities are expressed in oral health, both in relation to the health-disease process and from the perspective of oral health care[9].

From the educational point of view, the findings reveal a population with low education, in which 22.5% are illiterate and 42.5% have only incomplete elementary education. It should be noted that socioeconomic conditions interfere in the quality of healthcare, especially in the search for knowledge in health education, in the principles that govern the promotion and preventive measures between health education and oral health.

A study analyzing the socioeconomic characterization revealed that the most observed condition was that of four years or less of schooling, reported by 57% of the quilombolas, who felt influences in their lives as a result of oral conditions: 1.8% stopped having fun, 7.6% reported difficulty speaking and 10.5% mentioned embarrassment when smiling or talking[16].

Researchers emphasize that black people have a 22% increased risk of losing teeth, compared to whites, reinforcing the inequity in access to oral health that affects the majority of self-declared black people in Brazil, also as quilombolas[17]. In this circumstance, and corroborating the findings of this research, this is what was observed by other researchers, when referring to the fact that the main influx of the oral condition, reported by quilombolas in their daily life, was related to the smile.

Furthermore, among the main complaints about impacts on oral health, eating (12.9%), talking (12.5%) and sleeping (12.2%) were recorded. In this perception in the analysis formulated by this study, the researchers expose the shock of neglected oral health conditions in minority populations, reinforcing the need for public investments in these vulnerable communities[18].

One must consider the fact that, historically, oral health care models have evidenced the predominance of mutilating dental practices, as well as a mode of private organization, technical operation, which signal challenges, which are reflected in the path of oral health. Therefore, while the most favored social groups have access to private dental offices and treatment technologies that overvalue aesthetics, on the other hand, other social groups suffer from untreated caries, tooth loss, pain and dental infections, and even with greater difficulties in accessing dental services, which reflect signs of exclusion and social inequities[9].

## V. CONCLUSION

The significant association ( $p=0.031$ ) between the perception of general health (excellent, fair and poor) and having oral health problems confirms the fact that most participants who did not have oral health problems considered their health general as excellent, while those who presented two or more problems, only 7.1% consider having this classification.

The findings reinforce the fact that a poor oral health condition denotes a close relationship with the living conditions of this society, whether assisted or not by the public power. There is, however, a need for greater determination in this area, and public policies must be implemented in relation to oral health, especially in quilombola communities.

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# A study on the circulation and retention levels of a Digital Social Currency using an Agent-Based Model

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**Keywords**—Agent-based model, currency  
circulation, currency retention, digital social  
currency, strategic management.

**Abstract**—Social currencies are increasingly present in several countries around the world. From management point of view, this phenomenon means that issues such as currency circulation and retention have to be addressed by local managers. In this paper, we propose the Agent-Based Model as a strategic management tool for social currencies. To do so, we introduce a case of using this approach combined with reinforcement machine learning to study the circulation and retention levels of the Sarafu Digital Social Currency from Kenya. The use of this model to study these two aspects that, at first, antagonize one another, allowed us to obtain indicators on the existence of a currency users behavior that contributes to the increase both of the circulation and retention levels. Those indicators can help Digital Social Currency systems managers to elaborate better strategies related to the circulation and retention levels, increasing the social benefits produced by the currency use in the community. The use of an Agent-Based Model to simultaneously address two aspects of the social currency allowed us to study the interactions between those two aspects and constitutes a novelty, since all the cases found in the literature using this model in this field are focused on a single aspect of the currency

## I. INTRODUCTION

Social currencies, also called local, community or complementary currencies are increasingly present in several countries around the world. In 2002, approximately 5,200 communities in 58 countries used social currency systems [1]. Social currency managers need to address, at a local level, topics normally addressed at a national level, such as currency circulation and retention.

The purpose of this paper is to present the potential of the Agent-Based Model (ABM) as a strategic management tool to social currency managers through an example of its use in the study on the circulation level and the retention level of the Sarafu from Kenya, a Digital Social Currency

(DSC) based on blockchain technology issued by Grassroots Economics for the distribution of humanitarian aid.

Retention and circulation are seen as two antagonistic aspects of a currency, since common sense suggests that the lower the retention the greater the currency circulation. Some social currency systems even apply penalties, known as demurrage fees, for retaining the currency [2]. But the use of an ABM to study, through simulations, those two aspects allowed us to shed new light on the interactions between them, which would hardly be allowed by another methodological approach.

Social currencies are exchange instruments parallel to the national currency, issued by civil society with the aim of promoting sustainable development [3]. In addition to its use as a unit of account, that is, as a reference for exchanges and an instrument for appreciate goods, their use is restricted to a certain territory [4].

Several social currencies are going through a digitalization process and within this process there is an increasing adoption of DSC based on blockchain technology, creating the so-called social cryptocurrencies [5][6].

In this context, the Sarafu Currency is one of the most significant examples of social cryptocurrency used for local economic development and improvement of living conditions, being the object of study in numerous papers.

The process of creating Sarafu Currency was born in 2010 with Eco-Pesa, whose purpose was to be an ecological currency, used as payment for services of garbage collection, tree planting and accepted as payment in the registered commercial establishments' network. After seven months of use, the results obtained were 20 tons of garbage collected, thousands of trees planted and a 20% increase in sales from registered traders. The creators of Eco-Pesa later founded Grassroots Economics (GE) and over the next few years launched many social currencies in economically excluded communities in Nairobi and Mombasa [7]. One such currency was the Bangla-Pesa, which promoted a 22% increase in sales at local stores in just one week[8].

Another example was Sarafu-Credit, a social currency based on vouchers issued through zero-interest loans, backed by the assets of cooperative companies created with the help of GE. At the time Sarafu-Credit was being created, the Kenyan government accused Grassroots Economics of conspiring to undermine the national currency. GE won a court-case in 2013, proving the legality of Sarafu-Credit and the currency was implemented that same year, but it still had to deal with issues such as lack of trust and commitment from users before it took hold and incorporated the other currencies issued by GE [9].

In 2017, all currencies issued by GE merged into Sarafu-Credit. This unified currency was important in ensuring food security in communities in Kenya, where people who used the social currency consumed 78% more food than those who did not [10].

The Sarafu-Credit digitalization process began in 2018 with an approach that merged mobile payment technology with blockchain. Such approach allowed currency units in the form of tokens to be exchanged between electronic wallets installed in cell phones. A text messaging

technology was also used to allow access to the system for a larger number of communities' residents in Kenya who had cell phones without internet access [11].

This digitization process has reached an important milestone in 2019, when the Sarafu system returned on being a system of multiple digital social currencies. However, in January 2020, with the goal of saving costs, the blockchain-based digital currency platform on which the currencies were been issued needed to be replaced, that forced the switch from a multi-cryptocurrency system to a single-cryptocurrency system, the Sarafu Currency. Also in early 2020, GE officially formed a partnership with the Danish, Norwegian and Kenyan Red Cross Societies, which enabled the coming through of a pilot project using Sarafu currency in Mukuru, one of the largest slums in Nairobi. The project became an important response system to the effects of COVID-19 [7].

The use of Sarafu Currency in money transfer programs in Kenya throughout the Covid-19 pandemic has evidenced that even a small-scale transfer of social cryptocurrency can have a significant impact for recipients. There were, for example, increases in several socioeconomic indicators in the communities attended, such as an increase of US\$ 93.51 in the accounts' balance of these programs' beneficiaries, of US\$ 23.17 in the amount received monthly in social currency, of US\$ 16.30 in monthly expenses using Sarafu, of US\$ 6.31 in the average trade values made in DSC and of US\$ 28.43 in expenses with food and water. One of the characteristics of the money transfer programs that used the Sarafu Currency is the charging of retention fees (or demurrage fees) to decrease the currency retention level in order to increase its circulation level [12].

This paper aims precisely at studying how the levels of currency retention and circulation interfere with each other. For this, we used an ABM, which is a computational methodology that simulates systems of multiple interacting agents [13]. This methodology can also incorporate behavioral assumptions to assess the consequences of interactions between those agents to model the real world [14], and allowed us to study how the interactions between the currency users produce both the retention and the circulation of the currency. From now on, we will refer to currency users as "agents".

ABM has already been used in some studies on social currencies, which allows us to state that this is a promising approach. An ABM was used to estimate how the introduction of a social currency could accelerate economic processes in an agricultural region of the Russian Federation [15]. Another was used to analyze the parameters of a community currency in an Oregon county,

USA, in order to assess its impacts on the region's average household income [16]. The circulation of a community currency in mountainous areas of Japan was examined by the use of an ABM [17]. However, in the cases presented, the results produced by the models were focused on only one aspect of the use of DSC, be it the acceleration of processes, the impact on family income or the circulation of currency. In the present study, the ABM simulations were used to obtain indicators on two aspects of DSC, the level of currency circulation and the level of currency retention, in order to study how they influence each other, based on the analysis of behaviors and of the interaction that produce them.

From the results obtained in this study, we noticed that an agent behavior that contributes to the increase of currency retention can also contribute to the increase of its circulation, indicating that there are situations in which these two aspects do not antagonize each other.

The following section of this paper describes Agent-Based Model, reinforcement machine learning and how we measured DSC circulation and retention levels. In the sequence, we will present the results obtained and discuss them. Finally, we will talk about the conclusions.

## II. METHOD

To carry out our research, we used an Agent-Based Model, which is an innovative approach because it goes from micro to macro, that is, from the agents' individual and independent actions it produces the systemic behaviors studied. Therefore, it opposes traditional approaches, which goes from the macro to the micro and takes the object of study to break it into smaller parts, based on assumptions that cannot always be verified in the real world. Besides, ABM assumes that reality is complex and non-linear, that small causes do not always result in small effects and that causes do not accumulate in a stable way [18].

ABM usually consists of input validation, simulation, calibration/descriptive output validation and prediction/predictive output validation [19].

In the input validation phase, we collected the necessary information for the construction of the ABM, such as what types of agents exist and how each type behaves in relation to the aspects of DSC studied. This information must come from real data and from previous studies, which can be both quantitative and qualitative. That's why this phase is described as a validation in the theoretical level, which aims to make the model consistent with the theory on which the modeled system is based [20]. The information resulting from this stage, besides

being the basis for the construction of the ABM, can be useful to DSC managers, since they present a picture of the aspects studied and the behavior of agents at the time the study is carried out.

Simulation is the phase in which a computational algorithm emulates a real system, through the execution of subroutines that emulate the system's agents. Such subroutines, in turn, perform operations to reproduce the agents' behaviors, according to the parameters specified in the input validation. During the simulation phase, we have full control over the agent's behavior and over the conditions of the environment, allowing us to carry out experiments. We can also follow the simulation process step by step [21]. The results of the experiments can provide DSC managers with indicators on how changes in the behavior of agents and in the environment parameters would affect the studied currency aspects. Following the simulation process step by step allows the identification of important factors for the construction of systemic behaviors. These two characteristics were fundamental to reach the result presented in this paper, as will be seen forward.

In calibration phase, we change the agents' features and behavior, the environment parameters and the model itself in order to make the results of simulation being close to results from the real world [13]. Calibration incorporates descriptive output validation, defined as a process of comparing the data produced by the simulations with the real data [19].

To carry out this phase, we will use reinforcement machine learning, which is a method that allows identifying patterns through a trial and error approach [22]. This method consists of simulation, comparison of simulated values with real values and application of adjustment factors to input parameters.

The results of the processes of this phase allow DSC managers to better understand how the studied currency aspects are built from the interactions between agents. It also allows discovering behaviors that, at first, had not been noticed. Finally, it allows the comparison of numerous combinations of input parameters, as it assumes that there is no single "optimal" combination to obtain a result, that is, it admits that different combinations of parameters can lead to similar results [23]. For instance, the currency circulation level depends on the value and quantity of transactions as well as the value and quantity of benefit deposits. The reinforcement machine learning algorithm will test many combinations of these four parameters, identifying which ones produce the best results, until it finds one that produces currency circulation levels close to those seen in the real world.

The last phase of the Agent-Base Model is prediction/predictive output validation. The objective of prediction is to estimate a value or set of values at a future time, however, an ABM can also produce more qualitative predictions about the behaviors associated with the studied aspects, or about the agents' reactions to exogenous shocks [24]. Predictive output validation means verifying the proximity between the predicted results and the actual data as soon as there are real data available to make. In this kind of validation, we also analyze the causes of the predictions as being correct or incorrect and create a record with the results of this analysis. The results of this phase provide DSC managers with indicators on what to expect from the studied currency aspects in the face of several possible scenarios. This record of these results also helps to make more accurate future predictions and provides a sight of the possible evolution of the system.

The simulations of an ABM produce metrics that numerically represent the aspects of the Digital Social Currency under study. Such metrics must also be applied to real data, to allow the comparison between the studied aspects that were produced by the simulation with those observed in the real world. In this way, before an ABM is built, it is necessary to define the metrics that represent the aspects of the DSC that will be studied through it.

A possible metric for representing the level of circulation of a currency is velocity, defined as the ratio between the volume circulated and the monetary base. This metric was used to study the level of circulation of 9 social currencies, based on data from 2011 to 2013. However, the database we had on the Sarafu Currency did not contain information on the total amount of currency in the system [25].

To adapt the velocity metric to the available information, we replaced the total amount of currency by the amount of social currency introduced into the system. Therefore, the resulting metric was the ratio between the total value of purchase transactions and the total value of social currency entering the system in a unit of time. This metric can provide relevant indicators to DSC system managers. For example, if it presents values lower than 1, this means that there are less currencies circulating than entering the system, which may indicate that the insertion of new social currencies in the system is not contributing to increase the local economy and, therefore, actions to promote increased currency circulation need to be taken. In addition, the study of the variation of this metric over time can provide indicators of how the insertion of new currencies influences their level of circulation.

To measure the retention level, we defined an index calculated in a period between two balance increases by

dividing the sum of daily balances by the highest balance multiplied by the number of days in the period. This index assumes values between 0 and 1, and the higher its value, the higher the retention level. That is, it assumes higher values for agents that hold the currency longer and lower values for agents that hold the currency for less time. For example, for an agent that starts a 4-day period with a balance equal to 10 currencies and spend 9 on the second day, the ratio will be  $13/40$ . If, instead of occurring on the second day, the spend of 9 currencies occurs on the third day, the index value will be  $22/40$ . And if it occurs on the fourth day, it will be  $31/40$ . We also define average monthly retention ratio as the weighted average of retention ratios in a month.

### III. RESULTS

In this paper, we propose that there is a behavior that contributes to an increase in the retention level of a DSC and that can also contribute to an increase in its circulation. We came to this conclusion from analyzing the input validation and calibration processes. Therefore, we will detail the results obtained in these phases and the processes which led us to the conclusion of the existence of that behavior. We found other results in the prediction phase, however, as they are not part of this paper scope, we will not address them.

The input validation results indicated that the level of Sarafu Currency circulation was much higher in the second half of 2020 than in the first half. While in the first semester, the average level was 3.7, in the second it was 16.5. In October 2020, for instance, this level was over 43, meaning that for each Sarafu received by agents as a benefit, 43 were spent in purchase transactions.

On the other hand, the results showed that the retention level was high throughout 2020, being above 0.9 in almost every month, except in October, when it was in the range between 0.8 and 0.9.

The results of the calibration phase are not described numerically, but by the analysis of both the process of approximating the simulated results to the real results and the monitoring of the simulation process.

The calibration phase was performed by application of the reinforcement machine learning algorithm, whose objective was to find a set of adjustment factors that, when applied to the input parameters, would make the circulation and retention levels simulated to be close to the real levels. We expected to reach this objective after repeating the algorithm application a sufficient number of times. However, for the months in which the level of real currency circulation was higher, we found that, after

repeating the algorithm application a large number of times, the simulated circulation stabilized at a level below the real values (between 7 and 10) and the correction factors stopped producing significant effects on the simulated values.

To find out why the simulated values were not approaching the real values, we followed, step by step, the simulation process for the month of October 2020, in which there was the biggest increase in the level of currency circulation. Then, we noticed that, as the amounts or quantities of purchase operations increased, the balances of many agents dropped to 0, causing them to stop making purchases until they received new benefits. Besides, correction factors on values and quantities of purchase operations became innocuous for agents who had a balance equal to 0. We also realized that increasing the benefits makes agents buy again, but did not contribute to the increase in the circulation level, as this level is calculated by dividing the monthly total of purchases by the monthly total of benefits and an increase in benefits means an increase in the denominator of this division.

#### IV. DISCUSSION

For the study of the interaction between currency circulation and retention levels, the results of the input validation phase indicate that it is possible to have a significant increase in the circulation level without a decrease in the retention level. The average Sarafu Currency circulation level for the second half of 2020 was more than 4 times higher than the average level of the first half, however, the average currency retention level remained high throughout the year. There was a small decrease in the retention level in October 2020, and analysis of the actual data indicated that the probable cause of this decrease was that GE closed a large number of inactive accounts that month. However, this level increased again in the following months.

The calibration phase results, mainly the observations made in the simulation follow-up indicated the existence of real agents' behavior that had not been noticed in the input validation phase: real agents rarely spend all their balance in a single purchase. The high retention rates observed in the real data corroborate the existence of this behavior.

This behavior was incorporated into the simulated agents, in such a way that they started to spend up to a maximum percentage of the balance, in a single purchase. In this way, agents managed to maintain a positive balance to continue carrying out purchase operations, until receiving new benefits, allowing an increase in the level of currency circulation. Several maximum percentages were

tested for a single purchase and, with a limit of 40%, it was possible to approximate the simulated values to the real values for both the currency circulation level and the currency retention level. This double approximation is one more indicator of the existence of this behavior.

Therefore, the fact that agents show the behavior of spending only a percentage of the balance on a single purchase contributes to an increase in the currency retention level, but also contributes to an increase in the currency circulation level.

This result provides DSC managers with an indicator that can be taken into account in the strategic planning of actions to reduce the level of currency retention, such as the application of penalties for demurrage, for example.

We emphasize that the use of an ABM was fundamental to reach this result, as it was only noticed because of the analysis of the input validation and calibration phases, and by the step-by-step monitoring of the simulation phase. The fact that the ABM was used for the simultaneous study of the levels of circulation and retention of the DSC was also decisive. If we had only studied the level of retention, we could explain the high values observed only by the increase in the value and quantity of benefits. On the other hand, if we had only studied the level of currency circulation, we could explain the high values observed in some months only by the increase in the value or quantity of purchase operations.

This result is an example of the potential of using Agent-Based Models in DSC studies, especially when these studies refer to more than one aspect of currency.

#### V. CONCLUSION

In this paper, we presented a case of using an Agent-Based Model in the study of the circulation level and the retention level of the Sarafu Currency. The analysis of the input validation and calibration phases and the step-by-step monitoring of the simulation phase allowed us to reach the conclusion that the behavior of spending only a part of the balance on a single purchase contributes to the increase of both aspects studied.

This study can also be complemented by researches on how agents spend and retain their DSC over the period between receiving benefits. The results of such research would be incorporated into the ABM, helping to bring the results of future simulations closer to those observed in reality.

The development and application of ABM requires specialized personnel and sometimes computers with high processing power. However, we believe that the costs



involved in using an ABM are outweighed by its advantages.

As a strategic management tool, ABM provides DSC managers with relevant information for decision making. Such information can be obtained throughout the entire process of applying the model and allows managers to better understand how agents' behaviors determine important aspects of the system and how these aspects influence each other. The ABM also allows us to obtain indicators on the system's reaction to changes in the agents' behavior. In this way, we propose that social currency managers who use ABM will have a significant advantage for the strategic management of their social currencies.

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# A Review on Nickel Recovery of Batteries by chemical Process

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**Keywords— Batteries, chemical process,  
nickel, recovery, environmental impact.**

**Abstract—** *There is a growing concern about the environmental impacts that batteries can cause if there is no correct destination at the time of disposal. Therefore, this article presents a review on the recovery of nickel and metals that are contained in batteries through chemical processes. With this study, it is possible to better understand how some processes available for nickel restoration work and, after recovery, their possible applications in different areas. It is possible to notice during the review that many authors cite the use of some additives or alloys for doping, which brings higher rates of nickel recovery and reuse. The main objective of this review is to form a database with recent research and that it is possible to give direction to new laboratory experiments and future work.*

## I. INTRODUCTION

The generation of sustainable energy has been increasing every year, and consequently, it is necessary to store this energy for later use. Thus, it is recommended that this storage be in sustainable and economical energy converter systems. An energy storage system that is gaining ground are batteries, as they have different sizes, models and capacities. However, there is still much to be evaluated in this area, especially about the environmental impacts caused both in the production and disposal stages [4].

Studies in relation to environmental impacts have been carried out and updated every year. A way to get to know these studies better is through the International Conference on Heavy Metals in the Environment, which was created in 1975 in Toronto, Canada, where every two years it publishes research on topics related to heavy metals, soil contamination and consequences for the environment. Many of these surveys indicate that there are significant numbers of people with high levels of contamination and

diseases caused by heavy metals. This is mainly due to incorrect disposal, which end up falling into fertile planting soil and river sources that supply communities and irrigate crops [23].

World battery production accounts for several billion per year, and Ni-Cd and Ni-MH batteries are among the most used systems in recent decades, however, there has been a great concern regarding the disposal of used batteries, because the species of metals used to manufacture these batteries are highly toxic [8].

In addition to high production, there is another question that must be taken into account, which is the illegal import of batteries from Paraguay. As the city of Foz do Iguaçu is a triple border city, it becomes more susceptible to the illegal importation and commercialization of this material. According to data from the customs balance issued and published by the Federal Revenue, in 2019 there was an increase of approximately 150% in the seizure of batteries and approximately 66% in electronics, these numbers are a comparison between the years 2018 and 2019 [19].

In Europe, there are already regulations and legislation that require manufacturers of Ni-Cd and Ni-Zn batteries to recycle at least 75% of their weight and cadmium recovery to be as complete as possible. An advantage of these batteries is the recovery of nickel, as it is considered a strategic metal with great value in the market [8]. In the United States there are already programs for the collection and recycling of electronic waste, which is where the largest volume of batteries with these components is concentrated. In Brazil, it has not yet been possible to implement these programs, as the greatest difficulty encountered is the collection system, cooperation of people and efficiency in the process, there are only small actions in some Brazilian states that work trying to minimize the incorrect disposal of these materials [29].

In view of the above, a review of some recent studies was carried out dealing with the recovery of nickel and metals found in batteries, through different chemical processes, with the objective of formulating a database for new research and studies in the scope of recovery of these materials.

## II. MATERIAL AND METHODS

To select the articles used in this narrative literature review, the following keywords were used: (nickel and recovery); (batteries and recovery); (Ni-Cd). Web of Science, Scopus and Science Direct databases. After an electronic search, the complete articles were reviewed and the most suitable were included in this article.

### 2.1 Batteries

By general definition, the battery is also known as an electrochemical cell, and its main function is the conversion of chemical energy into electrical energy. This released electrical energy is generally the difference in binding energies of the metals, oxides, and molecules undergoing the electrochemical reaction [24].

Basically, batteries are formed by cathode, anode and electrolyte, and their reactions are known as redox reactions. The cathode and anode are electronic conductors, and the electrolyte is the ionic conductor. The anode is considered the negative pole because it is where the oxidation reaction takes place, that is, it is in this electrode where there is the process of loss of electrons. The cathode is considered the positive pole, where the reduction reaction takes place, that is, the gain of electrons during the process. The electrolyte is an ion-conducting liquid solution whose main function is to improve the performance of the electrodes [24].

Within this definition there are two groups of batteries that stand out, they are: the primary batteries, which are

sets of cells that do not perform inversion in their electrolytic reactions, that is, they cannot be recharged. And the secondary batteries, which are sets of cells that use electrochemical reactions that can be reversed, that is, the reagents that make up this system, can return quantities close to the initial ones only with the passage of electric current in their interior [20].

Taking as an example the secondary Ni-Cd batteries. In this type of battery, the positive electrode (cathode) is Nickel, and the negative electrode (anode) is Cadmium. The reduction and oxidation reactions, which occur at these electrodes, respectively, at the time of the electrochemical reaction, can be represented by (1) and (2). The electrolyte applied to these batteries is potassium hydroxide (KOH), along with small amounts of additives. with the aim of improving the performance of the electrodes [24]. In Fig.1 demonstrates the basic schematic of a Ni-Cd battery.

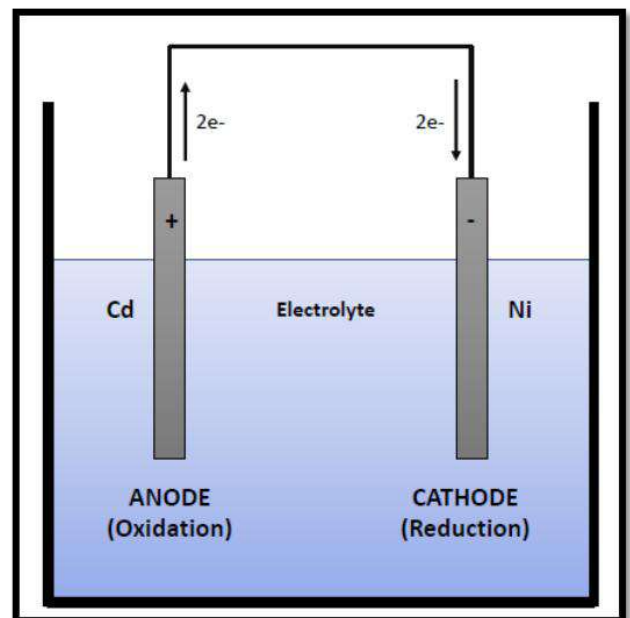
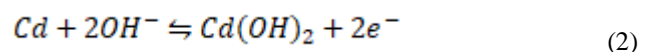
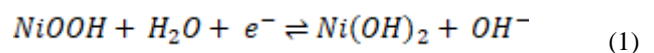


Fig. 1: Ni-Cd Battery Operation Diagram



## III. DISCUSSION

### 3.1 Recovery of nickel and metals contained in batteries: Hydrometallurgical processes

In recent years, many studies have emerged related to the treatment and recycling of Ni-Cd batteries through hydrometallurgical processes. The advantage of this process is that it can work at low temperature, as the

solutions generate little residual gas. The hydrometallurgical process involves a sequence of physical-chemical steps, one of the main steps being the leaching of waste and electrodeposition of a metal, carried out in a sulfuric medium, resulting in an active powder, also called "black mass" [8].

This experiment [8] deals with the separation and recovery of nickel and cadmium, through leaching and electrodeposition. The active powders used in the research were obtained from Ni-Cd batteries that were manually dismantled before the treatment processes. The characterization of the recovered active powder confirmed the presence of metallic hydroxides  $\text{Cd}(\text{OH})_2$  and  $\text{Ni}(\text{OH})_2$ , as it is a new combination of treatment processes, it was necessary to make several adjustments during the stages, but this treatment proved to be effective and promising for the recovery of nickel and cadmium found in the battery.

Other authors [18] have evaluated the recovery of nickel, cadmium and zinc by hydrometallurgical processes. The authors obtained an overall efficiency of the nickel leaching step of 73% at the anode and 93% at the cathode. It was also possible to identify that pure metallic nickel has a very low recovery percentage, around 26%, but with the addition of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) there is an activation of nickel, increasing the recovery of this metal and reaching approximately 90%. Within this study, very satisfactory results were obtained, using a concentration of 10% of diluted sulfuric acid, the recovery of metals reached 99%, when the temperature varied between 308-328 K.

Another recent study deals with hydrometallurgical processes using a new extractant called Cyphos IL 104 diluted in Toluene during leaching to recover cadmium and nickel. To obtain the active powder, the batteries were manually disassembled. After the leaching process, countercurrent extractions and pickling steps using simple pickling agents, the results were compared and it was possible to identify a recovery of approximately 99% of the metals, being recovered as useful nanometric oxides, which have applications in electronics and as a photocatalyst for pollutant degradation. The authors [10] concluded that Cyphos IL 104 is a promising extractant for this process, as there is economic feasibility and possible commercial use.

Another approach reported in studies for the recovery of nickel and cadmium from batteries is the steps of selective isolation and hydrothermal synthesis of nickel oxide (NiO) nanocuboids. Nanocuboids have a more attractive morphology, that is, they have high surface area and high structural stability, in addition to low expansion/contraction when compared to lithium-ion

batteries. In this process, after leaching with hydrochloric acid, the material was placed in an autoclave and subjected to the hydrothermal process at a constant temperature of 474 K. After cooling to room temperature, the obtained precipitations were washed repeatedly with distilled water and ethanol, and the dry powder was heated to 450 °C, resulting in the mesoporous nickel oxide (NiO) nanocuboids [3].

From the results of this research [3], it was possible to observe that the leaching process with hydrochloric acid associated with hydrothermal synthesis allows the recovery of about 77% of the nickel from the batteries. The analysis of the material obtained confirmed the high purity and porosity of nickel. The study opens the way for this method to be applied in preparations of other materials from electronic waste.

### 3.2 Recovery of nickel and metals contained in batteries: Chemical precipitation, Synthesis and Sonochemical process

Some authors [5][11][13][16][17][21][22][25][27] brought in their research the application of the chemical precipitation method for the recovery of nickel, cadmium and zinc from batteries. In all the studies cited, this technique proved to be very efficient and useful for the composition of positive results. Each research has its particularity and different details during the execution, but it is possible to verify that the same technique can be used in different purposes for the use of the recovered material.

Samples of single structure with mixed phase  $\alpha/\beta$  nickel hydroxide partially substituted with aluminum were prepared by chemical precipitation, and compared with samples of pure  $\beta\text{-Ni}(\text{OH})_2$ . The Al-substituted nickel hydroxide  $\alpha/\beta$  phase had a compact density of 2.02  $\text{g}/\text{cm}^3$ , a value significantly higher than the  $\alpha$  nickel hydroxide, which had a density of 1.70  $\text{g}/\text{cm}^3$ . When compared with pure  $\beta\text{-Ni}(\text{OH})_2$ , the mixed phase showed higher electrochemical activity, better electrochemical reversibility, lower electrochemical resistance and higher discharge voltage, making it a promising active material for alkaline secondary batteries [13].

Another method used for sample preparation is the controllable complex precipitation method. The authors [16] used this method to design  $\text{Ni}(\text{OH})_2/\text{C}$  nanocomposites, where  $\text{Ni}(\text{OH})_2$  nano plates are surrounded and supported by porous carbon. The porous carbon support was synthesized by heat treatment of polyvinylidene chloride. The results showed an increase in the specific surface area of the porous  $\text{Ni}(\text{OH})_2/\text{C}$  nanocomposites, promoting a better electrochemical performance, confirmed by cyclic voltammetry. The increasing intensity of redox peaks, the negative shift of

the oxidation peaks and the positive shift of the reduction peaks as the carbon content increases, is attributed to improved reversibility during the charge/discharge process and high electrical conductivity provided by the carbon support. With this new type of composite, it was possible to obtain a specific capacity of 345.2 mAh/g and even after 20,000 cycles its capacity remained at 97% of the initial capacity, which shows significant superiority in aspects of charge/discharge current density, specific capacity and life cycle.

Another study [1] carried out the synthesis of nickel hydroxide by the high-energy ultrasound method (sonochemical), using only oleylamine as a reducing agent, stabilizer and surfactant, and water as a solvent. The difference in the preparation of  $\alpha$ -Ni(OH)<sub>2</sub> and  $\beta$ -Ni(OH)<sub>2</sub> was only the adjustment in the reaction time. Three different nickel hydroxide phases were identified, with well-defined crystalline structures. In addition, the sonochemical method allowed the control of morphology and specific surface area, being able to be used for the preparation of products with different specifications.

In order to obtain new insights regarding the formation of hierarchical nanostructures of Ni(OH)<sub>2</sub>, The authors [15] carried out several experiments with different sources of nickel, such as nickel chloride (NiCl<sub>2</sub>), nickel nitrate (Ni(NO<sub>3</sub>)<sub>2</sub>) and nickel sulfate (NiSO<sub>4</sub>) and hexamethylenetetramine (HMT) was used as an alkaline source. The synthesis of the nanostructures occurred through the hydrothermal method. Due to the use of HMT, the predominant phase in the samples was  $\alpha$ -Ni(OH)<sub>2</sub>, although some differences were identified between samples due to different nickel sources. From nickel chloride or nitrate, the microspheres presented a flower shape, consisting of petal-like nanosheets, while the samples prepared with nickel sulfate resulted in two types of Ni(OH)<sub>2</sub> structures with different characteristics, one structure was the porous flower-like microspheres and the other was a mesh microsphere. From these results the authors suggested that the combination of alkaline and anion source selections may be useful for the fine control of the structures and morphologies of transition metal hydroxides.

A study [9] proposed the synthesis of Ni(OH)<sub>2</sub> nanosheets modified with nitrogen-doped carbon points (NCD), aiming to further improve the energy storage performance of Ni(OH)<sub>2</sub> for practical applications. With the correct (unspecified) addition of NCD it is possible to obtain an optimization of specific electrochemical capacitance of the nanocomposites Ni(OH)<sub>2</sub>/NCD. When compared with pure Ni(OH)<sub>2</sub>, the nanocomposites showed smaller size and thinner thickness. The assembled super capacitor containing Ni(OH)<sub>2</sub>/CD nanocomposites as

positive electrode and three-dimensional graphene as negative electrode demonstrated high energy density, and the authors concluded that nitrogen-doped carbon dots played a very important role as a structure steering agent, in adjusting the size and thickness of Ni(OH)<sub>2</sub>, being promising electrode materials for high performance.

A composite electrode in 3D format was developed, containing Ni(OH)<sub>2</sub>/carbon nanotubes (CNT)/carbon fiber (CF), for the purpose of treating wastewater containing urea. The methods of electrophoretic code position and hydrothermal treatment were adopted to combine the advantages of each chosen component. The prepared electrode demonstrated favorable electrocatalytic activity and this positive point can be attributed to the 3D conductive structure and modification with CNT, because in this pre-treatment there is an increase in the number of groups containing oxygen, this causes the attraction of Ni<sup>+2</sup> to the CF substrate to be more accelerated in the synthesis process. The Ni(OH)<sub>2</sub> catalyst is composed of the single phase of  $\alpha$ -Ni(OH)<sub>2</sub> and its crystallinity was improved with increasing hydrothermal reaction time. The Ni(OH)<sub>2</sub>/CNT/CF composite electrode exhibited a higher urea oxidation reaction current and a lower oxidation potential, that is, a lower electrode over potential. In addition, the composite electrode showed a lower charge transfer resistance, and this characteristic can be attributed to the increase of the surface area of the reaction and electrical conduction of the electrode due to the CNT. The phase transformation of Ni(OH)<sub>2</sub> into NiOOH can activate the oxidation of urea more easily, thus helping to decrease pollution and H<sub>2</sub> production during the treatment of urea-containing wastewater [14].

Nickel hydroxide has two polymorphs, known as  $\alpha$ -Ni(OH)<sub>2</sub> and  $\beta$ -Ni(OH)<sub>2</sub> phases. However, the commercialization of the  $\alpha$ -Ni(OH)<sub>2</sub> phase is limited due to problems of structural instability and low conductivity, being easily converted into another phase during some procedure. Due to this, the influence of sodium carbonate on structural stability and crystalline phase for nickel hydroxide doping was studied [26]. They were prepared by means of ultrasound-assisted precipitation. Four series of nickel hydroxide with different amounts of sodium carbonate were synthesized. The nickel source for this study was Ni(NO<sub>3</sub>)<sub>2</sub>·6H<sub>2</sub>O and the metal ion sources for doping were Al(NO<sub>3</sub>)<sub>3</sub>·9H<sub>2</sub>O/ Co(NO<sub>3</sub>)<sub>2</sub>·6H<sub>2</sub>O/ YbN<sub>3</sub>O<sub>9</sub>·5H<sub>2</sub>O. After the first evaluation, the samples underwent the aging process to evaluate the stability of  $\alpha$ -Ni(OH)<sub>2</sub>. It can be seen that there was a process of recrystallization during the aging treatment, and that sodium carbonate had different positive effects, proving to be useful for the formation and maintenance of the structural stability of  $\alpha$ -Ni(OH)<sub>2</sub>.

#### IV. CONCLUSION

Through this, it is possible to verify that currently there are several studies that allow the recycling and recovery of nickel and metals that make up used batteries. Some of this research demonstrate that by employing some additives, doping alloys or nickel support materials, the results obtained are even more satisfactory indices and high percentages of recovery and use. Some of these studies still bring the areas where reused materials can be better applied, thus having the best possible performance. It is still difficult to define just one type of treatment or chemical process, as each of them brings a different benefit that contributes to the recovery and reuse of nickel. The main objective was to compile studies that deal with the recovery of nickel, cadmium and zinc for possible reuse in several areas, thus having a database for future research and future laboratory tests in this area.

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## Quilombola Women in Brazil

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**Keywords— Women; Race; Territory;  
identity; quilombo.**

**Abstract—** *Quilombola women today represent important figures to understand the process of social constitution of the country, especially considering the condition that women still find themselves in society and in the struggle for equality. In addition, their relationship with the territory is an important example to understand the economic dynamics of Brazil as a whole. Thus, it is intended here to discuss what territorial identity represents for these women and how they relate to society, as well the current dynamics of the quilombo and especially of the women who compose it around the society of the region. Bringing together different approaches to create an initial scenario to understand the dynamics around quilombola territories, using to a large extent the representation, vision and relationships that quilombola women have on their territories. For this, it will use data and the existing bibliography that deals with gender, quilombos and the colonizing context itself that created the social dynamics seen today. As well as.*

### I. INTRODUCTION

The study of the *quilombola* situation in Brazil is still quite limited, which indirectly demonstrates the difficulties of being seen and heard not only socially, but also academically.

For a better understand of social relations around female figures in countries with a history of inequality, it is necessary to rethink the type of feminism in theoretical terms, which best applies and manages to understand these dynamics of peripheral women gender oppression is linked to racial and economic inequality. These economic and racial inequalities affect women even more perversely, as they are socially below white women and black men, thus making them even more vulnerable.

There are *quilombola* communities in at least 24 states in Brazil: Amazonas, Alagoas, Amapá, Bahia, Ceará, Espírito Santo, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Paraíba,

Pernambuco, Paraná, Piauí, Rio de Janeiro, Rio Grande do Norte, Rio Grande do Sul, Rondônia, Santa Catarina.

The *Palmares Quilombo* (by the end of the 16<sup>th</sup> century) was the first project of a successful self-title and agrarian reform in which everyone could live by sharing the little they had and the abundant productions that guaranteed the livelihood of the *quilombo*. After the long crossings, those who resisted, bodies violated by the punishments in the slave quarters, found peace of mind, healing of the soul, among their own people. A breath for those who didn't have the right to decide about their own body.

Kalunga, the largest *quilombola* territory in the country, covers three municipalities in Goiás: Cavalcante, Monte Alegre de Goiás and Teresina de Goiás, in the Chapada dos Veadeiros region.

*Quilombo*, in addition to being a search for autonomy, was a form of resistance and struggle against the slave system, was also a way of reacting to the cultural

disintegration to which slavery had been subjected. Many people sought to reach large established quilombos. Individual escapes became a common strategy in the 19th century, as slaves escaped constantly, they settled in large cities – such as Salvador – and pretended to be freedmen.

The historian and human rights activist Beatriz Nascimento (1985) developed an extensive work devoted to the understanding of the *quilombo's* concept, meaning and organization from Africa (specifically Angola) to Brazil and argued that the *quilombo* could be seen as a symbol of ethnic and political resistance that proclaims a way of living that had the possibility to correct distortions imposed by economic and political powers and unite people around other ideals, such as solidarity.

Because the *Quilombos* were communities formed by former slaves who had run away from the farms these places became centers of resistance for black slaves escaping from forced labor in Brazil, work done for farmers, who were certainly supported by the State (government) and the Church.

The formation of *quilombos* from the colonial period to the contemporary is linked to the violence derived from a racist ideology that dehumanizes the black woman and locates her as an infra-human category, which justifies and authorizes violence, which fixes identity policies and promotes the appropriation of their territories as a commodity (Fernandes & Santos, 2016).

After the legislation of the Federal Constitution of 1988, with art. 68 and its advances in 2003 with Presidential Decree 4.4887/2003, which formalizes the guarantee of the right to land and the recognition of *quilombola* communities through their self-attribution, the processes of recognition of *quilombola* communities throughout the country are leveraged. Reaching its peak in 2006 with the recognition of 400 communities. With the recognition processes, the struggles of communities for the sovereignty of their territories and the guarantee of access to their basic rights take over (Fernandes & Santos, 2016).

*Quilombola* communities are groups with their own cultural identity and were formed through a historical process that began in the times of slavery in Brazil. These communities maintain a strong connection with their history and trajectory, preserving customs and culture brought by their ancestors.

The political struggle of *quilombola* communities is presented in a field of ambiguities between the possibility of access to land and affirmation of their identity, and at the same time, the protection of their ways of life by the State, and the objectification of their lives by the market. that capitalizes on traditional ways of living in

the form of marketable products (Santos, Massola, Silva, & Svartman, 2016).

Decree 4,887/03 defines, in its article 2, *quilombola* communities or remnants of quilombo communities, ethnic-racial groups, according to self-attribution criteria, with their own historical trajectory, endowed with specific territorial relations, with presumption of black ancestry related to the resistance to the historical oppression suffered and that the characterization of the remnants of the quilombo communities will be attested through the self-definition of the community itself.

The Brazilian Institute of Geography and Statistics (IBGE) estimates that 1,108,970 people live in indigenous areas and 1,133,106 live in quilombos in Brazil.

The people of the quilombo are a happy people, who like music and dance. Among the *quilombolas* there are a large number of singers and songwriters, who recount in their songs the life, struggle and hope of their people. The so-called traditional festivals are the result of many influences: black, indigenous and Catholic.

CONAQ (National Coordination of Quilombola Communities) estimates that in Brazil the *quilombolas* are approximately two million people, or 130 thousand families, present in all Brazilian states. A large part of this population still lives in rural areas and far from urban centers, as the birth of quilombos unfolds from the need for refuge for blacks who managed to escape enslavement, which lasted in the country for more than 300 years (from 1530 to 1888). Currently, these communities are spaces for the maintenance and resistance of black culture, of African ancestry and their survival is linked to the leadership of black women.

*Quilombola* communities are constituted as self-determined traditional territories based on the ethnic and racial origin of their residents, which is why they are supported by Convention 169 of the ILO (International Labor Organization).

The norm guarantees these groups the right to control the land and activities that ensure their survival and economic development, as a way of strengthening and maintaining their identities.

The country has approximately 2,500 certified communities, according to data from the Palmares Cultural Foundation/Ministry of Culture. Statistical data do not have the necessary disaggregation to identify who is a quilombola in the total numbers referring to Brazilian rural communities, which makes thousands of women and men invisible to specific public policies. The lack of access to

the rights to health, education, quality public transport, as well as the legal instability regarding the right to their own territory, reveal how institutional racism limits the dignified survival of this population.

Women are in a more problematic situation. While men migrate to the nearest cities in search of work, they remain. There, they guarantee sustenance, based on the management of natural resources, acting for the social organization and transmission of ancestral knowledge.

*Quilombolas* are exposed to various forms of violence, they are the main ones impacted by territorial conflicts, development projects and the suppression of rights, which significantly compromises the social and economic development of these women. Even in this adverse scenario, these communities resist, marked by female and black protagonism.

As part of the Black Women strategy Towards a 50-50 Planet by 2030, UN Women interviewed *quilombolas* Célia Cristina da Silva Pinto, National Coordinator of CONAQ (National Coordination of *Quilombola* Communities), and Maria Rosalina dos Santos, State Coordinator of *Quilombolas* of Piauí and also a member of the National Coordination.

They talk about the reality of *quilombolas*, acting as leaders in the communities and the debate in the Federal Supreme Court (STF) on the constitutionality of decree 4,887/2003.

The demands of the leaders interviewed are in line with the recommendations contained in the Plan of Action of the International Decade for People of African Descent 2015-2024, especially with regard to the protection of their territories, which is a prerequisite for achieving a Planet 50-50 in 2030.

And mirroring these women and so many other anonymous people in the country, that we, *quilombola* women, fight against the invisibility of our fight against racism, machismo and against all kinds of discrimination and violence in this unfair, racist and unequal society.

*Quilombola* women are the holders of traditional knowledge, prayers, natural medicine and typical foods. They were and are important in the social and productive organization and in resistance strategies.

Black *quilombola* people, we have been fighting for centuries against racism that hinders and often prevents the full development of our quilombos. For many years our struggle did not have the support of the Brazilian State, as this was the one who supported and legalized the monstrous exploitation of our bodies and our work, through the nefarious slavery. We fought and conquered

that freedom 131 years ago, but we still have a long way to go so that our people can live in peace and with dignity.

In a retrospective, the struggles of *quilombola* women intertwine the resistance struggles of *quilombos* in Brazil. Historically, we follow the steps that come from afar with Dandara dos Palmares, Tereza de Benguela, Maria Aranha, Zacimba Gaba and so many other important women for the continuity of the struggle today. And mirroring these women and so many other anonymous people in the country, that we, *quilombola* women, fight against the invisibility of our fight against racism, machismo and against all kinds of discrimination and violence in this unfair, racist and unequal society. Many *quilombola* women hold the positions of presidents of associations, federations and leadership in the *quilombo*.

*Quilombola* women had and still have an extremely important role in the struggles of resistance, maintenance and regularization of territories.

Whether in the quilombo or in the city, these women have been the guardians of the Afro-Brazilian cultural traditions, in addition to taking care of the house, the children, the elderly, the sick, the farm, the animals and the preservation of natural resources.

They were and continue to be fundamental in the *quilombos* struggle for their rights. Currently, many *quilombola* women face the fury of farmers, land grabbers, often paying with their lives to defend the people.

The participation of *quilombola* women in policy definition spaces has guaranteed the proposition of public policies that take into account the gender, racial and generational cut, since they play an active role in society, take their demands and denounce institutional racism, invisibility, domestic, sexual and psychological violence and the absence of the state in their communities.

However, the Constitution would have to protect us, but he is our biggest violator, in a racist structure in its most perverse faces. However, we fight and resist, we are more than 6 thousand quilombos in Brazil in the states: Alagoas, Amapá, Amazonas, Bahia, Ceará, Espírito Santo, Goiás, Maranhão, Minas Gerais, Mato Grosso, Mato Grosso do Sul, Pernambuco, Piauí, Paraíba, Pará, Paraná, Rio Grande do Sul, Rondônia, Rio Grande do Norte, Rio de Janeiro, Sergipe, Santa Catarina, São Paulo and Tocantins.

In these sacred spaces that we worship our ancestry, our way of living, preserving the woods and forests, the rivers, seas, not contaminating the land that feeds us and keeps us on our feet, in the face of so many setbacks, withdrawals of rights and we watch without

believing tear up the Federal Constitution in broad daylight.

It should be noted that the organicity of quilombos today stands out for the proposal to add, in addition to the blacks who broke the process of enslavement, our ancestors who proudly follow their teachings, in an ancestral territory that teaches us collectivity, sharing, reflections so important nowadays, only those who have stepped barefoot in a sacred territory know the surrender and the life that pulsates in the heartbeat and in the pulsing blood.

### 1. Women and the quilombo

The struggles of *quilombola* women within their communities generally represent a major contribution to feminist movements. But in addition, they represent strong characteristics of strength to maintain the history of quilombos throughout the country.

In addition, they form a solid link with their history to maintain the (re)existence of being *quilombola* and black women in the country.

When *quilombola* communities organize themselves for the right to ancestral territories, they are not only fighting for the demarcation of lands, to which they have an absolute right, but, above all, they are asserting their rights to a way of life.

In the midst of the territory, they are part of, they develop not only as women, but also as *quilombola*, since it is in that environment that they develop their daily relationships. In this sense, understanding oneself as black and *quilombola* is very much like a political act, as it is understanding oneself to be part of a whole history of oppression. Being generally associated with a struggle against domination

In this context, the struggle for territory is the first factor in achieving equality. These women fight to be sovereign of their bodies and their territories, thinking the territory here is not only about a land, but also about the place where stories were built and are built. It is where the *quilombola* woman finds her protection, not only from what she considers herself, but also, because it is from their own territory, that these women can seek tools to alleviate violence and inequalities.

### 2- Quilombos nowadays

Women are the main figures who project and maintain the representation of the *quilombo* in their communities. This process is not just a reflection of the maternal role, in which the creation of new generations has an important role in the preservation of an identity and the territory is thought of as a self-reflection on Brazilian society.

Recognition is the first step towards achieving the full rights of *quilombola* communities. First, recognizing their identities and histories, so that their territories that maintain and reproduce such identities are recognized. In addition to being the place of subsistence of the community itself in the midst of its kinship and community relations, or its economic relations that depend on the territory to a large extent.

Thus, it is observed that these quilombos fight against dynamics of domination coming from an external economic context that takes possession of the still colonizing and excluding Brazilian society, which is in constant exchange with a foreign capitalist elite.

Black women today are the main figures in the moon for a more just, egalitarian and, above all, safer society, they are to a large extent the ones who relate to society, and even if they are not the majority in terms of decisions in the quilombos, it is perceived that within different communities they represent the majority. In addition to being increasingly organized politically.

Finally, *Quilombola* communities are currently one of the most vulnerable population groups in the country and fall into the category of traditional communities, since the essential feature of their characterization is the preservation of a culture different from the majority, maintaining a relationship with the land that, more than possession or property, it is an identity relationship. It is within the fragile structure of these communities that the *quilombola* woman has her life shaped and controlled by the nexus of gender, race, color, ethnicity and other lines of subordination and, in the face of a society marked by prejudice and the lack of opportunities, both in the countryside of work and in the social, political and historical field that *quilombola* women see themselves below the lowest strata of society.

In view of this recognition of the vulnerability of groups such as *quilombolas*, Afro-descendants and women, we find the need to go deeper in the study of their problems and try to find greater legal effectiveness of the institutes already constituted in our legislation.

## II. CONCLUSION

Colonial racism forged in more than 350 years of slavery still dominates the state and permeates the minds and actions of that country's political and economic elites.

But whoever broke the shackles of slavery with the strength of his people will not stop fighting, even when conditions prove to be adverse. The struggle story of Acotirene, Dandara, Zumbi dos Palmares and Negra

Anastácia, among so many other fighters, is the strength and inspiration that leads us to our daily toil.

Another battle fought daily by *quilombola* communities takes place in the field of law. Understanding the intricacies of Brazilian legislation allows for taking firm positions in the defense of rights and in denouncing abuses and injustices.

To highlight the different forms of intersectional oppression such as violence against black women, food insecurity, the lack of appreciation of their ethnic-racial identity in schools, machismo still present in communities (the president of the Federation of *Quilombola* Communities is a man) and institutional racism, among others. Even in the face of these oppressions, *quilombola* women exercise their protagonism and fight for the claim of rights for their communities.

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## Monitoring of biodigesters through a computerized system integrated to IoT platform

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**Keywords—** *Biodigester, Anaerobic  
Digester, Monitoring System, Internet of  
Things.*

**Abstract—** *The purpose of the biodigester is to provide the proper treatment of organic waste that would be inappropriately disposed of in the environment. These residues in their decomposition process are responsible for the release of gases that cause the greenhouse effect, such as carbon dioxide (CO<sub>2</sub>) and methane gas (CH<sub>4</sub>). In this context, the objective of this work was the construction of a computational system that would allow the real-time monitoring of the parameters of physical quantities involved in the digestion process, applied to the study of filters for biogas. For the development of this work, four prototypes of batch digesters were built, adapted with electronic sensor modules to collect, and send data in real time, through the IoT (Internet of Things) platform. Hardware and embedded software platforms based on low-cost microcontrollers using Industry 4.0 concepts were used. The parameters monitored by the sensors were: concentration of methane (CH<sub>4</sub>), carbon dioxide (CO<sub>2</sub>) and hydrogen sulphide (H<sub>2</sub>S), temperature, humidity, and gauge pressure in the biogas. It is concluded that the biodigesters monitoring system through the ability to monitor factors in real time allows a better understanding of the anaerobic digestion process, allowing a better analysis and optimization, as well as the performance study of the elements involved in the process such as biomass, filters, and environmental factors.*

## I. INTRODUCTION

In Brazil, cattle and swine farming are among the agricultural activities responsible for a large part of greenhouse gas (GHG) emissions, making it necessary to adopt measures to mitigate these emissions. One of the main strategies is the construction of anaerobic digesters so that there is an adequate treatment of the waste generated in these properties. The adoption of this method shows that the emission levels of these gases can be reduced (GARCIA JUNIOR, PIRES & DA CUNHA *et al.*, 2016; ALCÓCER *et al.* 2019).

The digester is defined as a hermetically closed chamber in which a process called anaerobic biodigestion of an organic compound occurs (NOGUEIRA, 1986).

In this process, a series of microorganisms act by transforming molecules of complex organic matter into simple structures that, when metabolized, result in a mixture of gases and a series of reduced compounds (SILVA *et al.*, 2012).

Such a process can be used in several applications that minimize the environmental impacts that would be caused by the incorrect destination of organic waste, having as a by-product two new value-added products, namely: biogas, which can be used as fuel for several applications, and the biofertilizer, which can be used as organic fertilizer in plantations (ALCÓCER *et al.*, 2014; BARREIRA, 2011).

According to reports by Alcócer *et al.* (2019) in practical experiments to implement biodigesters on properties in rural areas, this equipment has the following advantages for use: sustainable management in the destination of organic waste; affordable cost for deployment and operation; production of biofuel and biofertilizer that add value to the project; and environmental sustainability and improvement in soil characteristics through non-contamination with animal waste.

The dissemination of anaerobic digester technology has been a proposal of relevance for sustainability, whose environmental and economic results have been positive for both owners and the environment (PINTO *et al.*, 2018).

Biogas is the popular name used to refer to a flammable mixture of gases that are generated when organic material undergoes anaerobic digestion. This mixture usually contains 40% to 70% methane, 25% to 45% carbon gas, and the remainder hydrogen, nitrogen, and hydrogen sulfide. This mixture has good caloric power and can be used as fuel or to generate electricity indirectly (ABBASI, TAUSEEF & ABBASI, 2011).

The biofertilizer consists of a residue obtained through the process of biodigestion, which can be diluted in water to be used directly in the crops through fertigation or after

going through a drying process, being considered as a high quality fertilizer in agriculture (MILANEZ *et al.*, 2018).

Monitoring and control are extremely important strategies to achieve adequate stability and greater efficiency in the anaerobic digestion process. Monitoring is a fundamental requirement for better control of the process, in which the lack of adequate indicators can result in losses in the efficiency of the biodigestion process. An ideal indicator tends to reflect on the state of the process and should be easy to access and simple to use, parameters such as temperature variation among others are considered valuable in decision making, always aiming to keep the process functioning in balance (BOE *et al.*, 2010).

Despite the vast literature on biodigesters and the process of anaerobic digestion, a lack of data collection on the control and monitoring of physical quantities and the reactions that occur in biodigesters was identified, especially in rural areas, in which the use of sustainable technological tools would promote a better efficiency in the biogas and biofertilizer generation process.

The purpose of this research was focused on the modeling and construction of a solution for electronic monitoring in real time of the parameters of physical quantities occurred during the anaerobic digestion process, using a computational technological system that will be responsible for the collection through electronic sensors, storage and analysis of data that will be accessible via the Internet. The solution here entitled: UNIBIO - Biodigesters Monitoring System.

Through this system, the following parameters could be monitored during the anaerobic digestion process: concentration of gases (sulfide, methane, carbon); temperature, relative humidity, and gauge pressure of the gas chamber; temperature of the biomass and of the external environment to the biodigester.

In this context, the objective of this work was to develop a computer system for real-time electronic monitoring of parameters of physical quantities that occur during the life cycle of the anaerobic digestion process in rural biodigesters connected to the internet through an IoT platform.

## II. MATERIAL AND METHODS

The present research is of an applied nature and of a descriptive character using an experimental method through a quantitative approach. To meet the specific objectives of this proposal, the methodology was divided into four stages.

### 2.1. Batch Biodigester Prototype

In the first stage, to support the experimental phases of the research as well as the validation of the computational

system to be built, the modeling and construction of 4 (four) prototypes of batch digesters that were compatible with the proposed electronic monitoring system was elaborated. Which resulted in the model shown in Fig. 1.

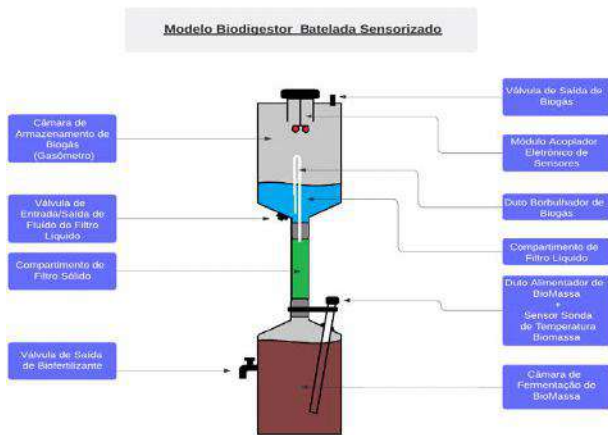


Fig. 1: Batch Biodigester Model  
Source: Produced by the author (2021)

The following features were used in the prototypes: anaerobic environment in the biomass chamber, valve for loading primary biomass, unloading valve for processed biomass, biodigestion vessel, biogas storage vessel (gasometer); removable compartment for filters (solid and liquid) of biogas; coupling with electronic sensor module device; and low-cost materials to enable the application of the equipment in small farmers in the rural area.

2.2. Hardware

In the second stage, the biodigester monitoring system hardware was developed based on an ATMEGA2560 microcontroller on an Arduino-compatible platform, consisting of 2 (two) physical modules, as shown in Fig. 2.

Electronic sensor module, located in the biodigesters, has the following characteristics: universal coupling in any biodigester model; easy access for maintenance, inspection, and sensor replacement; suitable for use in critical operating conditions in environments subject to weather conditions such as exposure to sun, rain, wind, humidity, temperature variations and corrosion.

IoT controller module, presenting the following characteristics: controlling the biodigesters' sensor modules; capture the reading values of all sensors; process the readings and send them to an online database on the internet; manage connectivity through media (wifi / 2g/3g/4g mobile network); ability to store collected data for a period of 90 days; have a failure control system for data security, in case of problems with access: to the internet, to the web server and to the database server; and allow the storage of data locally when the system is offline;

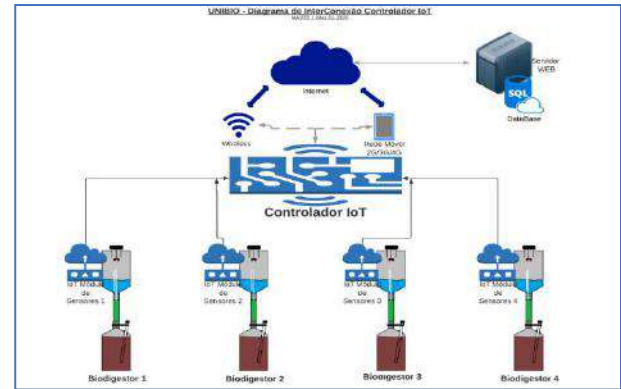


Fig. 2: IoT Connectivity and Sensor Modules Diagram  
Source: Produced by the author (2021)

2.3. Software

During the third stage, the software used in the solution were designed, whose objective was to build a system for real-time monitoring and analysis of data obtained during the anaerobic biodigestion process.

The biodigesters monitoring system was called the UNIBIO system and is represented according to the diagram shown in Fig. 3.

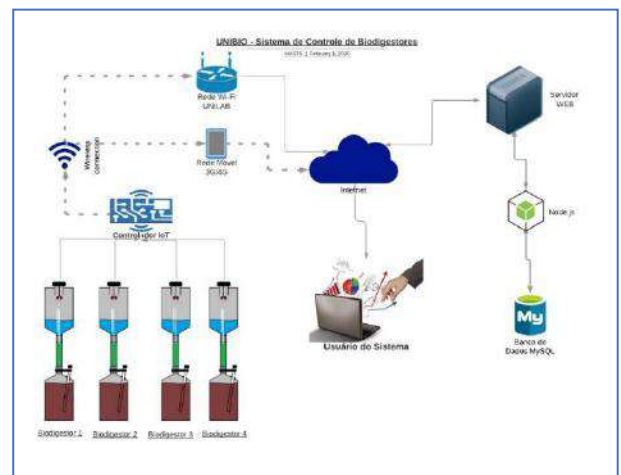


Fig. 3: Functional Structure Diagram of the UNIBIO System  
Source: Produced by the author (2021)

The macro view of the development of the software architecture of the UNIBIO system can be classified into two parts: the REST API server and the Web Client Application.

The REST API Server was responsible for providing an interface that served as a basis for other parts of the system. The REST architecture was chosen because it provides a simple and direct interface to access services on the internet, especially in IoT applications, in addition to offering good performance (DE MELO SILVA et al., 2016).

Maalej & Robillard (2013) define an API as a contract between the component that provides functionality and the



component that uses the functionality (the client), allowing the reuse of libraries and frameworks in software development.

The Web Client application was responsible for providing the end user with a way to interact with the data from the monitored biodigesters. It can be accessed by any device connected to the internet that has a web browser.

The Web Client application has the function of performing the registration of biodigesters projects in the UNIBIO system, according to the functions described below: accessing graphs and data report of the monitored biodigesters; monitor the real-time monitoring of biodigesters; and register and catalog new projects of biodigesters; efficiently consult the information consolidated in the database of the

The DBMS chosen for the implementation was MySQL because it has a GPL license and has broad community support, being one of the most used DBMSs on the market today.

The data model was defined following the normalization of the data, prioritizing the speed of queries, the scalability of the system and the prevention of future problems. Allowing the inclusion of new biodigesters to the system without the need for code changes.

The communication of the modules of the UNIBIO system takes place through an API, providing better data security, scalability of the system and simplification of complexity.

The embedded software used in the IoT microcontroller was developed in the C++ programming language, which is an object-oriented language and because it is a native language of the Arduino IDE programming tool along with the C language for the microcontrollers used in the project. (ATMEGA2560 and ESP-8266) you have greater control over the resources of microcontrolled devices.

#### 2.4. Anaerobic Digestion

The fourth step of the methodology was carried out with the anaerobic digestion experiment using the four prototypes of biodigesters monitored with sensors, and each prototype used a different combination of filter for the biogas as shown in Fig. 4.

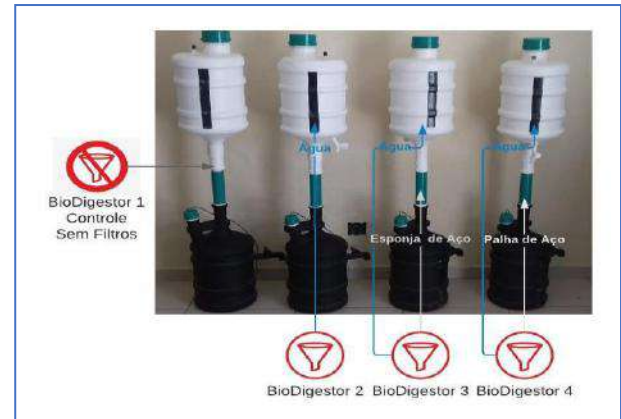


Fig. 4: Arrangement of Filters in Biodigesters

Source: Produced by the author (2021)

The prototypes were organized as follows: prototype 1: control element had no filter; prototype 2: filter: water column (10 cm); prototype 3: filter: water column (10 cm) + steel sponge column (20 cm); and prototype 4: filter: water column (10 cm) + steel wool column (20 cm).

Two repetitions of the experiment were performed. The first experiment took place between the dates (06/07/2020 and 08/10/2020) and the second experiment between the dates (04/16/2021 and 06/04/2021) in the city of Fortaleza, state of Ceará at the coordinate's latitude (-3.8414890), longitude (-38.482589) and altitude (28 meters).

The biomass used was composed of 36 liters of fresh bovine manure diluted in 36 liters of drinking water at room temperature (26°C), later the 72 liters produced in the mixture were used to feed the 4 digesters homogeneously with 18 liters of biomass. each one.

#### 2.5. Sensors

Sensors are electronic devices that send electrical signals according to the variation of the physical or chemical phenomenon that they propose to measure, with the objective of relating information through the output signal with the quantity to be measured, such as temperature, speed, current, among others (THOMAZINI & DE ALBUQUERQUE, 2020).

In the construction of the biodigester sensor modules, the components as shown in Table 1 were used.

Table 1: Sensors used in UNIBIO Monitoring

Item	Description	Qty	Type	Reading Interval	Unit
1	Methane gas sensor	4	Analog	300 to 10,000	ppm
2	Hydrogen sulfide gas sensor	4	Analog	1 to 200	ppm
3	Carbon dioxide gas sensor	4	Digital	0 to 5,000	ppm
4	Pressure sensor	4	Analog	0 to 1,200	kPa
5	Humidity and temperature sensor	4	Digital	0 to 95	%RH
				-40 to 80	°C
6	Temperature probe sensor	4	Digital	-55 to 125	°C

Source: Produced by the author (2021)

### 2.6. Sensor Calibration

For the calibration of the sensors, the methods recommended by the manufacturer in the datasheet of the components were used, in addition to each specific sensor was compared with an industrial calibration equipment. After the individual calibration of each component, a method called set calibration was applied, in which the four sensor modules of the project were subjected to the same gas sample in a controlled environment and the reading values for each sensor were compared.

After the completion of the biodigestion cycle, measurements were carried out on the gases stored in the four prototypes of batch digesters with the professional equipment gas analyzer GEM5000.

## III. RESULTS AND DISCUSSION

### 3.1. Batch Biodigesters Prototypes

As a result, the benchtop batch biodigesters developed to carry out the anaerobic digestion process were built in 4 prototypes as shown in Fig. 5.



Fig. 5: Constructed Prototypes of Biodigesters  
Source: Produced by the author (2021)

These prototypes showed the following characteristics during use in anaerobic biodigestion tests, with positive characteristics to be highlighted: easy biomass feeding and filter loading at the beginning of the process; easy disassembly after the end of each cycle, being practical to discharge the waste substrate after the digestion process; easy washing of the biodigester to prepare the device for cycle restart; good sealing and retention of odors expelled by equipment and use; and good mechanical resistance of the biodigester equipment, preventing the appearance of cracks and biogas leaks

### 3.2. Monitoring Hardware

The construction of the sensor modules for the digester and the IoT controller module were carried out, which allowed real-time communication of the monitored digesters with the internet through the IoT platform, with the result as shown in Fig. 6.

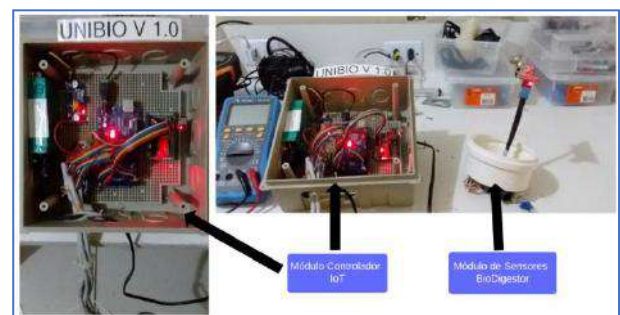


Fig. 6: IoT Controller Constructed Module  
Source: Produced by the author (2021)

The hardware components such as the IoT controller and the sensor module for the biodigester had their functioning fully in accordance with the requirements for which they were defined, with the following highlighted results: the operation of the system uninterrupted throughout the period of biodigestion, having its adverse failure control system successful in data preservation in case of contingency

saving on local memory card in sporadic failures of communication channels with the cloud, so data can be synchronized when re-establishing communication channels maintaining integrity the data collected by the sensors; and the biodigester sensor modules achieved easy coupling with the biodigestion device and simplified access for maintenance.

### 3.3. Monitoring Software

The software systems modules developed for the UNIBIO system presented the expected performance and performance for the proposed objectives. The results achieved with Software modules are as follows:

The UNIBIO system made it possible to create a register to catalog new or already implemented biodigester projects in the field. In Fig. 7 the screen of biodigester projects registered in the system is displayed.

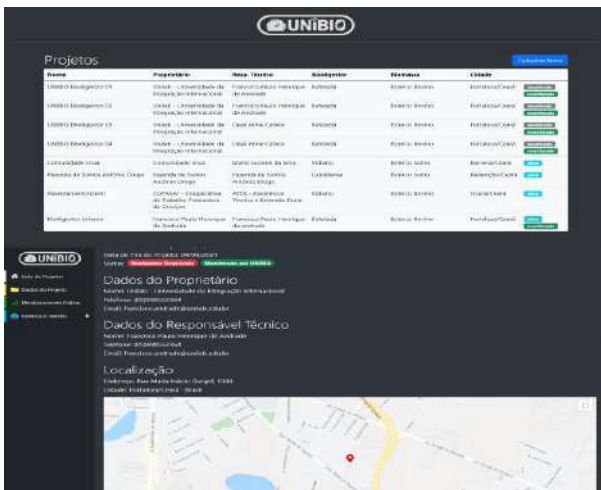


Fig. 7: Screen of Registered Projects  
Source: UNIBIO System (2021)

The system presented the functionality of visualizing in real time the updated parameters of the readings of the sensors installed in the monitored digesters, issuing alerts to the user in case any parameter exceeds the predetermined limits for the monitored data. As illustrated in Fig. 8.



Fig. 8: Biodigester Online Monitoring Screen  
Source: UNIBIO System (2021)

Fig. 9 shows the Cartesian graph of the gases read as: methane gas, carbon dioxide and hydrogen sulfide during

the anaerobic digestion process, followed by the data table of these gases.

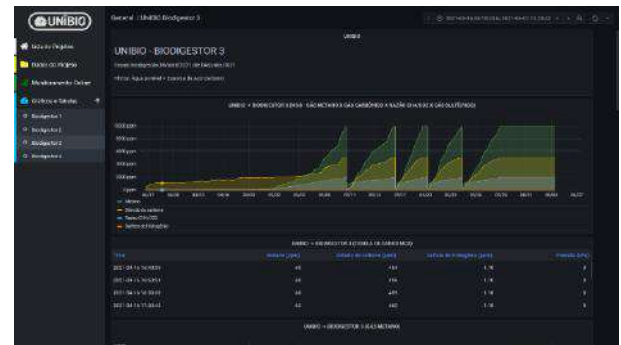


Fig. 9: Comparative Table of CH<sub>4</sub> Gases  
Source: UNIBIO System (2021)

Fig. 10 shows a comparison of the readings performed on the four prototypes of biodigesters for the measurements of hydrogen sulfide.

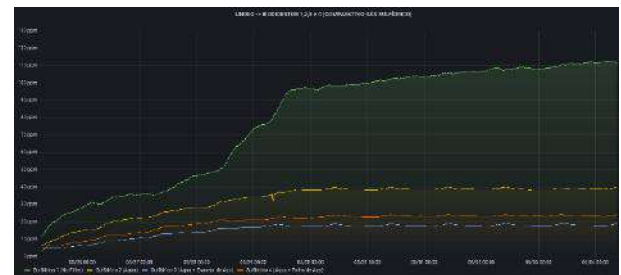


Fig. 10: Comparative Chart of H<sub>2</sub>S gases  
Source: UNIBIO System (2021)

Fig. 11 shows a comparison of the readings performed on the four prototypes of biodigesters for carbon dioxide measurements.

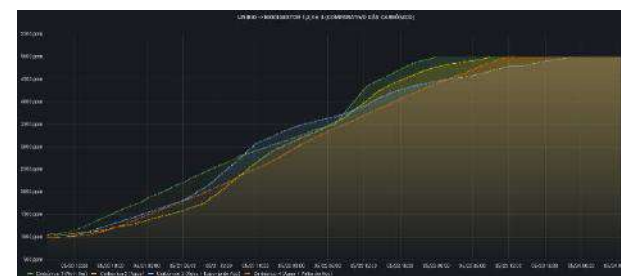


Fig. 11: Comparative Chart of CO<sub>2</sub> gases  
Source: UNIBIO System (2021)

Fig. 12 shows the Cartesian graph represented over time of parameters such as temperature variations (gasometer, biomass and environment), relative humidity variation and internal gauge pressure of the biogas chamber.



Fig. 12: Temperature x Humidity x Pressure  
Source: UNIBIO System (2021)

### 3.4. Anaerobic Biodigestion Results Analysis

The anaerobic biodigestion process was carried out in the four biodigester prototypes to study the biogas filters, with the test repeated later to validate the results obtained. The data collected by the system are presented in consolidated form in Table 2.

It was observed that: The application of filters generates a thermal barrier that retains greater heat in the biomass during periods of exposure to the sun; The application of the liquid filter layer with water greatly increases the relative humidity of the air dispersed in the gasometer; The temperature in the biomass, during the process, was kept within the safe margin for the conservation of the biological health of the anaerobic digestion process. The set of filters (Biodigester3: Steel Sponge + Water) had the best

performance, followed by the set (Biodigester4: Steel wool + Water) which had the second best performance in biogas filtration.

### 3.5. Filter Performance and Data Analysis

From the database generated by the electronic monitoring during the anaerobic biodigestion test, which was accessible through the WEB client module of the UNIBIO system. We obtained the following consolidated data readings for the 4 prototypes, as shown in Table 3.

Under the Table 3 were considered for data reading, due to the reading limits of the methane and carbon dioxide gas sensors being respectively 10,000ppm and 5,000ppm, the moment when the CO2 sensor reached a reading of 5,000 was considered as the cut-off point. ppm in each cycle.

For calculating the proportion of methane / carbon dioxide present in the biogas. At this point, a reading of 4,600ppm for carbon dioxide was considered, compensating for the initial presence of 400ppm of Co2 in the atmospheric air that was present in the gasometer at the beginning of each cycle.

Soon after the methane gas sensors reached the 10,000ppm mark, the gasometer chambers were emptied so that the sensor reading cycles could be restarted. The process of anaerobic digestion, however, continued uninterrupted. The sensors began to read the new concentrations of gases as they were being generated by the

Table 2: Consolidated Report of Readings Biodigester UNIBIO

	Biodigester 1 No Filters		Biodigester 2 Filter: Water		Biodigester 3 Filters: Water + Steel Sponges		Biodigester 4 Filters: Water + Steel Wool									
	1st Test	2nd Test	1st Test	2nd Test	1st Test	2nd Test	1st Test	2nd Test								
temp. MAX Biomass	29.7°C	30.8°C	32.2°C	31.5°C	32.6°C	32.3°C	32.8°C	31.3°C								
temp. MIN Biomass	26.1°C	23.1°C	25.6°C	23.5°C	25.1°C	23.8°C	24.9°C	23.6°C								
temp. MAX Gasometer	39.8°C	47°C	38.5°C	44.9°C	38.2°C	43.4°C	39.1°C	42.3°C								
temp. MIN Gasometer	24.1°C	25.5°C	23.8°C	25.9°C	23.7°C	26°C	24.1°C	24.3°C								
HR MAX Gasometer	92%	89%	95%	95%	95%	95%	95%	95%								
HR MIN Gasometer	68%	50%	78%	83%	79%	81%	76%	88%								
	ppm	%	ppm	%	ppm	%	ppm	%								
CH <sub>4</sub> gas	7350	61.5	7251	60.7	8920	65.9	8576	64.9	9550	67.4	9278	66.7	9385	67.1	8998	66.1
CO <sub>2</sub> gas	4600	38.4	4600	38.5	4600	34	4600	34.8	4600	32.5	4600	33.1	4600	32.8	4600	33.8
H <sub>2</sub> S gas	67	<1	88	<1	24	<1	31	<1	8	<1	16	<1	12	<1	18	>1

Source: Produced by the author (2021)

Table 3: Data Collected in the UNIBIO System for Biodigester 1

BIO	Cycles	Time (Days)	Reading CO <sub>2</sub> (5000 ppm) Date/Time	Pressure (kPa)	CH <sub>4</sub> ppm	CO <sub>2</sub> ppm	H <sub>2</sub> S ppm	MCS* CH <sub>4</sub> (%)	MCS* CO <sub>2</sub> (%)
1	Cycle 1	22	05/07/2021 16:41	3	7081	4600	130	59.95	38.95
	Cycle 2	7	05/14/2021 12:14	3	7288	4600	101	60.79	38.37
	Cycle 3	4	05/18/2021 01:58	3	7272	4600	97	60.76	38.43
	Cycle 4	4	05/23/2021 03:07	3	7297	4600	58	61.04	38.48
	Cycle 5	4	05/28/2021 15:31	3	7315	4600	54	61.12	38.43
	Average Values - Biodigester 1:					7251	4600	88	60.73
2	Cycle 1	23	09/05/2021 20:36	4	8476	4600	30	64.68	35.10
	Cycle 2	6	05/15/2021 21:35	4	8605	4600	29	65.02	34.76
	Cycle 3	4	05/19/2021 03:44	4	8594	4600	33	64.97	34.78
	Cycle 4	4	05/23/2021 12:03	4	8608	4600	31	65.02	34.75
	Cycle 5	5	05/29/2021 01:23	4	8596	4600	34	64.97	34.77
	Average Values - Biodigester 2:					8576	4600	31	64.93
3	Cycle 1	24	05/10/2021 06:07	4	9052	4600	16	66.23	33.66
	Cycle 2	6	05/16/2021 00:45	4	9333	4600	16	66.91	32.98
	Cycle 3	3	05/19/2021 14:28	4	9337	4600	17	66.91	32.96
	Cycle 4	4	05/24/2021 01:33	4	9327	4600	17	66.89	32.99
	Cycle 5	5	05/28/2021 19:21	4	9339	4600	16	66.92	32.96
	Average Values - Biodigester 3:					9278	4600	16	66.77
4	Cycle 1	24	05/10/2021 03:07	4	8870	4600	17	65.76	34.11
	Cycle 2	6	05/16/2021 02:17	4	9031	4600	18	66.17	33.70
	Cycle 3	3	05/19/2021 10:26	4	9034	4600	17	66.18	33.70
	Cycle 4	4	05/23/2021 16:13	4	9035	4600	19	66.17	33.69
	Cycle 5	5	05/28/2021 10:45	4	9022	4600	20	66.13	33.72
	Average Values - Biodigester 4:					8998	4600	18	66.08

\*MCS Proportion: Percentage in relation to the total sum of gases read (Methane Gas + Carbon dioxide + Hydrogen Sulfide Gas)

Source: Produced by the author (2021)

biodigester. Table 4 presents the consolidated result of the performance of the biogas filtration system.

It can be seen from Table 4 that the set of filters that obtained the best performance in filtering biogas was the one present in the Biodigester 3 set composed of carbon steel sponge + Drinking water.

According to Alcócer *et al.* (2019) the expected values for the composition of the biogas generated from bovine manure vary between the values: Methane Gas (from 55% to 75%), Carbon Dioxide (25% to 45%), Hydrogen Sulfide (<1%) and other gases (<5%). In which the values obtained in the monitored biodigesters are within the expected margins in the literature for the type of biomass involved.

It was observed in the anaerobic digestion process a more accentuated production of hydrogen sulphide after the first 20 days until approximately 30 days of biodigestion process, showing a sharp drop after the first month.

The UNIBIO system also allowed the detailed visualization of the temperature variation and relative humidity of the air in the biodigester. Taking biodigester 1 as an example, we can see that the biomass reached a minimum temperature of 23.1 °C and a maximum temperature of 30.8 °C throughout the anaerobic biodigestion cycle, thus staying within a safe range for the biodigestion process that it is between 15 °C and 40 °C (SOUZA, 1984).

Table 4: Consolidated result of all prototypes (biodigester 1,2,3 and 4)

Prototype	Filter		CH <sub>4</sub> (ppm)	CO <sub>2</sub> (ppm)	H <sub>2</sub> S (ppm)	Gases Proportion		Filtering performance	
	Liquid	Solid				CH <sub>4</sub> (%)	CO <sub>2</sub> (%)	CO <sub>2</sub>	H <sub>2</sub> S
Biodigester 1	No filter	No filter	7251	4600	88	60.73	38.53	4th	4th
Biodigester 2	Potable water	No filter	8576	4600	31	64.93	34.83	3rd	3rd
Biodigester 3	Potable water	Steel sponge	9278	4600	16	66.77	33.11	1st	1st
Biodigester 4	Potable water	Steel wool	8998	4600	18	66.08	33.78	2nd	2nd

Source: Produced by the author (2021)

#### IV. CONCLUSION

It is concluded that the development of a biodigester monitoring system through the IoT platform with hardware support through microcontrollers and low-cost sensors, in which we call this solution the UNIBIO system, proved to be technically and financially adequate for application in systems of anaerobic digestion, providing data that enable decision making that results in improved efficiency and optimization of the anaerobic digestion process. It allows measuring and quantitatively comparing the performance of different biomasses in the production of biogas as well as analyzing the efficiency of filter elements for the biogas produced.

The values obtained by the monitoring system were within the levels expected by the literature and are suggested for future research. The continuity of tests with the UNIBIO system using other sources of biomass and new combinations of biofilters.

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## Vegetative growth of radish in different organic substrates

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**Keywords**— *Raphanus sativus*,  
*Vermicompost*, *Organic waste*,  
*Quixabeira tree*

**Abstract**— The present work had like objective to evaluate the effect of different organic substrates on the vegetative growth of radish cultivar *Crimson Giant*. It was utilized a completely randomized design with five treatments and four replications. The substrates rated were T0 - washed sand + sawdust; T1 - washed sand + sawdust + vermicompost; T2 - washed sand + sawdust + 'Quixabeira soil'; T3 - washed sand + sawdust + cattle manure and T4 - washed sand + sawdust + broiler litter. were rated the plant height - AP (cm), fresh matter weight of the aerial part - MFA (g), dry matter weight of the aerial part - MSA (g), fresh matter weight of the root - MFR, dry matter weight of the root - MSR (g) and root diameter - DR (cm). observed that there were a significant effect of the treatments, in which the best vegetative growth was obtained in the T4 substrate.

### I. INTRODUCTION

The radish (*Raphanus sativus* L.) is an annual vegetable belonging to the Brassicaceae family and has been gaining prominence among vegetable growers, due to its attractive characteristics (rusticity, small size and short cycle). Produced mainly by small and medium farmers and with little expressive production in Brazil, it concentrates greater production in the south and southeast regions. In the northeast region, the states of Bahia and Pernambuco concentrate the largest number of producers [1].

It is characterized by being a short cycle plant (25 to 35 days), however, it needs high amounts of nutrients, responding positively to potassium fertilization even in soils with high potassium content [2].

It is a crop widely produced under conventional management, which includes sowing in the definitive location, use of soluble mineral fertilizers and cattle manure as the main organic matter added.

However, there is a need to adapt the production system to the reality of each region and to the different profiles of farmers. This need is the great incentive to carry out studies

on alternative management, such as the use of substrates for production in pots or beds on shallow soils, use of substrates in soils with low cation exchange capacity and water retention, use of substrate for seedling production and studies on the use of alternative organic materials.

Earthworm humus, Quixabeira soil, cattle manure and poultry litter are materials with great potential for use in radish production, providing nutrients and increasing water retention capacity. It is important to emphasize that the chemical composition of these materials is variable and therefore they can present different responses when added to the soil or substrate [3] [4] [5] [6] [7].

In this context, it is important to explain in a special way that the Quixabeira soil is a material made up of the litter of the tree *Bumelia sertorium*, popularly known as Quixabeira. This is a species that provides organic matter with great potential to improve soil properties [8].

Based on the above, the present work aimed to evaluate the effect of different compositions of organic substrates on the vegetative development of the radish cultivar *Crimson Giant*.

## II. METHOD

The experiment was carried out in a greenhouse, at the Universidade do Estado da Bahia, UNEB, Campus XXII of Euclides da Cunha-BA. The municipality of Euclides da Cunha/Ba is located at 10° 30' 27" south latitude and 39° 00' 57" west longitude of Greenwich, with an altitude of 472 meters above the sea. The area is part of the "Drought Polygon". According to the Köppen classification, the climate of the region is sub-humid, with a dry winter. The average annual temperature is 22°C. The hottest month is October, with temperatures up to 38°C and the coldest is July, with average values close to 20°C. Annual rainfall varies from 500 to 750 mm.

The design used was completely randomized with five treatments and four replications. The evaluated treatments consisted of five different substrate compositions, being T0 – washed sand + sawdust in the proportion of 1:1; T1 – washed sand + sawdust + earthworm humus in the proportion of 1:1:2; T2 – washed sand + sawdust + quixabeira soil in the proportion of 1:1:2; T3 – washed sand + sawdust + cattle manure in the proportion of 1:1:2 and T4 – washed sand + sawdust + poultry litter in the proportion of 1:1:2. In each treatment the materials are mixed and homogenized.

*Crimson Giant* radish seeds from the Feltrin company were used, sown at a depth of approximately 2 cm in disposable cups (200 ml) containing the substrates for each treatment. The humidity in the substrates was maintained

with manual irrigation throughout the experimental period, according to the water needs of the crop.

At 22 days after emergence (DAE) the following parameters were evaluated: plant height - AP (cm), fresh mass - MFA and shoot dry mass - MSA (g), fresh mass - MFR and root dry mass - MSR (g) and root diameter - DR (cm).

The collected data were submitted to analysis of variance and the means were compared by the Scott - Knott test at 5% probability. Statistical analyzes were processed using the statistical program SISVAR 5.6 [9].

## III. RESULTS AND DISCUSSION

A significant effect of treatments was observed at the 5% level for all variables analyzed at 22 DAE. The highest values for plant height (AP) were obtained in substrates T1 (washed sand + sawdust + earthworm humus), T2 (washed sand + sawdust + quixabeira soil) and T4 (washed sand + sawdust + poultry litter) with an average of 4.52 cm; 5.10cm and 5.92cm respectively (FIGURE 1).

Means followed by the same letter in the column do not differ from each other by the Scott-Knott test at 5 % probability.

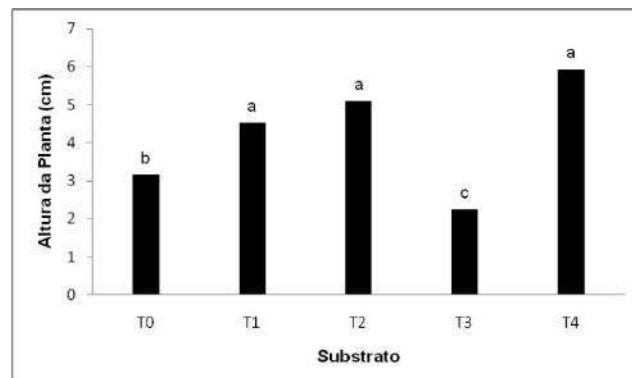


Fig.1 – Plant height (AP) of radish cultivar *Crimson Gigante* cultivated under different organic substrates.

The greatest increase for the fresh mass (MFA) and shoot dry mass (MSA) variables was provided by the T4 substrate, in which averages of 2.06g and 0.18g were obtained, respectively (FIGURE 2).

Means followed by the same letter in the column do not differ from each other by the Scott-Knott test at 5 % probability.



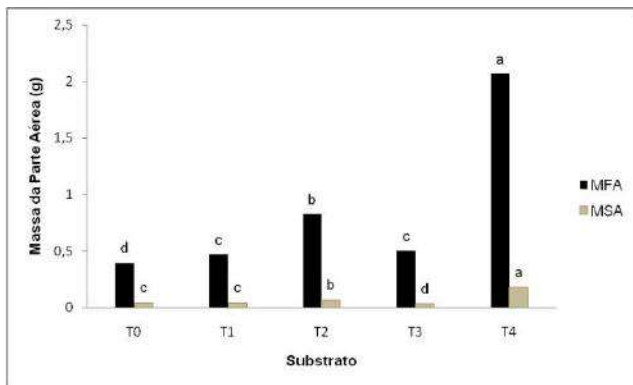


Fig.2 – Fresh matter weight of the aerial part (MFA) and dry matter weight of the aerial part (MSA) of radish cultivar *Crimson Gigante* cultivated under different organic substrates.

Substrate 4 favored greater development of the radish root system in the initial phase of growth, in which the average values expressed for the variables root fresh mass (MFR), root dry mass (MSR) and root diameter (DR) were 1.77g; 0.45g and 0.75cm respectively (FIGURE 3 and 4).

Means followed by the same letter in the column do not differ from each other by the Scott-Knott test at 5 % probability.

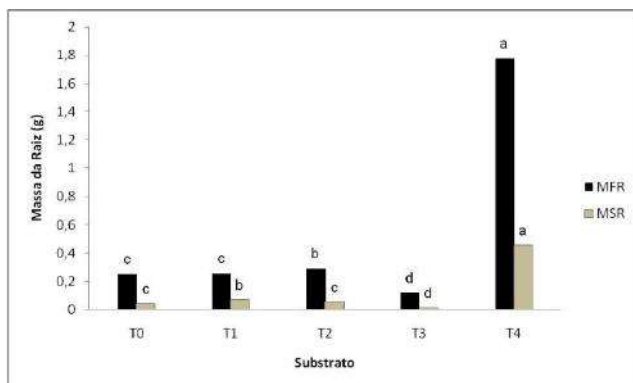


Fig.3 – Fresh matter weight of the root (MFR) and dry matter weight of the root (MSR) of radish cultivar *Crimson Gigante* cultivated under different organic substrates.

Means followed by the same letter in the column do not differ from each other by the Scott-Knott test at 5 % probability.

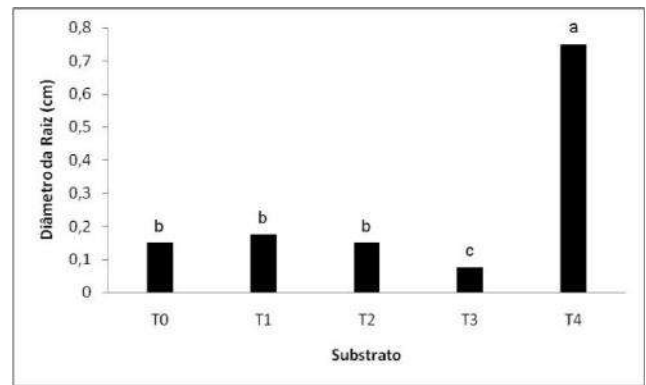


Fig.4 – Root diameter (DR) of radish cultivar *Crimson Gigante* cultivated under different organic substrates.

This response to the T4 substrate (Figure 5) indicates the most effective action of the poultry litter in the development of the radish, although the analyzes were carried out in the vegetative stage of the culture, it is acceptable to infer that the substrate composed of washed sand, sawdust and poultry litter has the potential to promote greater development of the culture, also in the productive phase.

It is important to emphasize that higher values of MFA and MFR indicate greater photosynthetic capacity and water and nutrient absorption, fundamental processes for plant growth and development.



Fig.5 – Radish cultivate Giant Crimson (*Raphanus sativus L.*) 25 days after sowing . (A) - T0 ( washed sand + sawdust ); (B) - T1 ( washed sand + sawdust + vermicompost ); (C) - T2 ( washed sand + sawdust + 'Quixabeira soil '); (D) - T3 ( washed sand + sawdust + cattle manure ) and (E) - T4 ( washed sand + sawdust + broiler litter ). Pimenta et al. (2018)

This more effective T4 substrate response may be related to the higher levels of nutrients present in poultry manure, mainly NPK. Araujo et. al. (2009), working with urea, cow and chicken manure, observed that the application of chicken manure compost, at the lowest dose (1 kg m<sup>-2</sup>), was sufficient for the greatest increase in dry mass production in *Brachiaria decumben* [5].

In a study on the application of increasing doses of natural phosphate in radish, Cláudio (2018) observed an increase in plant height, shoot fresh and dry mass, root fresh and dry mass and root diameter [10]. The same behavior was observed by Bonela et. al (2015) who, when evaluating different sources of organic matter for the cultivation of

lettuce, obtained a greater increase when using chicken litter [11].

#### IV. CONCLUSION

The T4 substrate – washed sand + sawdust + poultry litter in the proportion of 1:1:2 favored the best vegetative development of the Crimson Gigante radish.

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## The role of health professionals in the care of patients with prostate cancer: Literature review

### A atuação do profissional de saúde nos cuidados do paciente com neoplasia prostática: Revisão de literatura

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**Keywords—** Prostate cancer, Incidence, Treatment.

**Palavras chaves—** Câncer de próstata,

**Abstract—** Prostate cancer is a malignant disease that is commonly linked to advancing age in men, it is a disease that is not restricted only to the prostate. The objective of this study was to analyze the importance of care provided by health professionals to patients with prostate cancer. The methodology is a thorough analysis of literature reviews published between the years 2010 to 2021 containing the subject of prostate cancer. The working population is made up of men, the elderly, who have symptoms of prostate cancer. A bibliographic review will be carried out on the subject in the scientific journals available online, gathering and comparing the different data found in the consultation sources and listing the main factors that predispose to prostate cancer as well as the characteristic signs and symptoms that could lead them to predisposition. Descriptive study with literature analysis. In Brazil, prostate cancer is the second most common

***Incidência, Tratamento.***

*among men. In absolute values, it is the sixth most common type in the world and the most prevalent in men, representing about 10% of all cancers. Health education collaborates so that people can live together in the most beneficial way possible. It is concluded that the nursing professional should contribute to the dissemination of preventive actions against prostate cancer, such as: elaboration of educational campaigns, lectures, conversation circles, among other activities that always aim at male inclusion.*

**Resumo**— *O câncer de próstata é uma doença maligna que está comumente ligada ao avanço da idade dos homens, trata-se de uma doença que não se restringe somente a próstata. O objetivo desse trabalho foi analisar a importância dos cuidados prestados pelos profissionais da saúde ao paciente com neoplasia prostática. A metodologia trata-se de uma análise minuciosa em revisões bibliográficas publicadas entre os anos de 2010 a 2021 contendo o assunto referente ao câncer de próstata. A população do trabalho constitui-se por homens, idosos, que apresentam sintomas de câncer de próstata. Serão realizadas revisão bibliográfica sobre o tema nas revistas científicas disponíveis on-line, reunindo e comparando os diferentes dados encontrados nas fontes de consulta e listando os principais fatores que predispõe o câncer de próstata assim como os sinais e sintomas característicos que puderam leva-los à predisposição. Estudo de caráter descritivo com análise de literatura. No Brasil, o câncer de próstata é o segundo mais comum entre os homens. Em valores absolutos, é o sexto tipo mais comum no mundo e o mais prevalente em homens, representando cerca de 10% do total de cânceres. A educação em saúde colabora para que as pessoas possam conviver da forma mais proveitosa possível. Conclui-se que o profissional de enfermagem deve contribuir na divulgação de ações preventivas do câncer de próstata, como: elaboração de campanhas educativas, palestras, rodas de conversas, entre outras atividades que visa sempre a inclusão masculina.*

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## I. INTRODUCTION

Cancer is a degenerative disease that occurs with the disordered growth of cells and can encompass more than 100 malignancies, as mutations in cells can cause an aggressive process in adjacent tissues, such as distant organs, very quickly with control, causing the formation of tumors. that can move to other parts of the body. These processes are called transfers (SILVA, 2015).

The different types of cancer correspond to the various types of cells that start in the epithelium of our body, and these cells are called carcinomas. They start in the connective tissue bones, muscles, cartilage called carcomo (BRASIL, 2021). Another difference is the appearance of cancer and the type of cancer where cell proliferation occurs and has the ability to replicate in adjacent tissues and organs, called metastasis (CRISTO & ARAUJO, 2011).

Various cancer treatments go a long way toward treating and even curing. for various treatment modalities.

Non-descriptive chemotherapy used before surgery can reduce tumor size, increase chemotherapy and be used to support the surgical procedure to eliminate the possibility of metastases in patients with the disease (FERNANDA et al, 2014).

Chemotherapy in pill capsules, a liquid that can be seen in the daily lives of nursing professionals who care for cancer patients undergoing chemotherapy, can observe different effects of chemotherapy treatment. Along with diarrhea and vomiting, gastrointestinal disease is one of the most reluctant diseases, the consequence of which is malnutrition, which can lead to multiple metabolic imbalances in patients (KARKOW, 2015).

Health professionals play an important role in monitoring to mitigate side effects and take positive actions through the physical and emotional adjustment of patients undergoing chemotherapy (LEAL, 2016). The role of nurses in these patients' camps is important in the

development of preventive measures and actions to reduce the negative effects of chemotherapy (LEAL, 2016).

Implementation of nursing in the systematic organization I mentioned. Hospitalization determines the impasse caused by the administration of chemotherapy. Faced with the various symptoms that chemotherapy brings to the lives of chemotherapy patients, nurses have the responsibility to provide chemotherapy patients with quality of life before and after chemotherapy. better (LEAL, 2016).

The process of adaptation and coping with the new reality changes the daily life and the family environment, so it is essential to understand and work on the changes caused to the diagnosed so that it is possible to understand the situation. Family support is even more important in this situation, and should be a source of strength to overcome it. However, there are still problematic effects and then the mental stabilization capacity, especially for spouses (PEREIRA et al., 2017).

How should the health professional camp for elderly cancer patients be carried out? The general objective was to provide a review of the literature on the role of nurses in the care of elderly patients with cancer. The general objective was to provide a review of the literature on the role of nurses in the care of elderly patients with cancer.

As the elderly population increases and new causes of cancer are discovered in this condition, there is a need for research and scientific production of materials to improve the techniques used by nursing professionals to provide a better quality of life. Patients receiving chemotherapy (ZUCOLO, 2014).

Chemotherapy associated with elderly patients has shown good results for the effective cure of several types of cancer, but it has more adverse side effects in patients over 60 years of age who, in addition to being limited by age, have already experienced the effects of chemotherapy (LEAL, 2016).

## II. MATERIALS AND METHODS

This is a qualitative study through a comprehensive literature review. This type of scrutiny makes it possible to analyze scientific research in a systematic and broad way, facilitating the characterization and dissemination of the resulting knowledge. Its purpose is to collect and synthesize research results on a specific topic or issue in a systematic and orderly manner.

The following inclusion criteria were used: articles available in full, which understood the objectives of the study, published in the time frame from 2010 to 2021, in scientific journals and online libraries, in Portuguese,

English and Spanish. The exclusion criteria were research published in congresses, blogs, forums or that did not meet the objectives or period of the study. To this end, 14 scientific articles related to the subject were analyzed, publications between the years 2010 and 2021 in databases such as: National Library of Medicine (PUBMED), Literature, Latin American and Caribbean in Health Sciences (LILACS), Library Virtual Health Department of the Ministry of Health (BVS), Scientific Electronic Library Online (SciELO), Brazilian Journal of Nursing (REBEN) and Google Scholar.

The bibliographic research had as a problem question: How should the health professional make the camp for the elderly cancer patient? Articles that sought to explain the subject were selected, which were in Portuguese, English and Spanish.

The organization of this review took place between December 2021 and February 2022, providing researchers with guidance relevant to the topics in question so that they can develop hypotheses for children who seek solutions to common problems associated with care. provided in a previous study.

This study did not need to be submitted to the Research Ethics Committee (CEP), as it was a study based on a literature review and all study data were analyzed and written in Microsoft Word®.

## III. LITERATURE REVIEW

A hallmark of cancer cells and their ability to spread to other organs, in a process called metastasis, categorizes different types of cancer based on the types of cells and organs in which some of the more common types of cancer are developing. Common are: lung, breast, colorectal, stomach and prostate, and the ones that leave more survivors are: breast, prostate, colorectal and uterus, but they can also develop in other organs such as: Anus; Bladder; Mouth and oropharynx; Colorectal; Head and neck; Nasal Cavity; Oral Cavity and Oropharynx; Cervix of the Uterus; Endometrium; Esophagus; Stomach; Liver; Gastric; Adrenal Gland; Salivary glands; Larynx and Hypopharynx; Leukemia; Mama; Melanoma; Multiple myeloma; Nasopharynx; Neuroblastoma; Eye; Ovary; Osteosarcoma; pancreas; Skin; Prostate; Lung; Kidney; Uterine Sarcoma; Testicle; Thymus; Thyroid; Bone Tumors; Vagina; Vesicle; Biliary Pathway; Vulva. Among other numerous types of cancer (CANDICO, 2016).

The risk factors for the development of certain types of cancer are mainly (about 80%) directly related to genetic factors, but these factors are easily potentiated when related to increased environmental pollution, physical

inactivity and smoking, in addition to people's aging. The world population, a fact that has led to an increase in cancer cases in the last decade (ZUCOLO, 2014).

Even with advances in medicine and pharmaceutical science in the development of new drugs and alternative treatments that have improved the recovery rates of cancer patients over the years, cancer still causes a large number of deaths each year, making it the second cause of death in Brazil, with approximately 190,000 deaths per year (BRASIL, 2017).

As life expectancy has increased over the years, the number of cancer cases is increasing every year, which requires qualified professionals to identify early and assist during treatment, 70% of cancer diagnoses in Brazil are made in people over 60 years of age, concerns the fact that 60% of cases are diagnosed in more than 70% of the population, reinforcing the importance of adequate treatment (INCA, 2021).

According to the World Health Organization, a quarter of the world's men aged between 60 and 79 have developed or will develop some type of cancer among women of the same age group, and the incidence is even higher, with one in three cancers being the second leading cause of death worldwide, causing 9.6 million deaths worldwide in 2018 Behavioral food risk High body mass index Low fruit and vegetable intake of cancer deaths are caused by infection (INCA, 2020).

In 2020, the National Cancer Institute estimated that there were 449,090 new cases of non-melanoma skin tumors in men and women. Estimates also point to the possibility of 625 thousand new cases of cancer across the country in the triennium 2020-2022, and excluding cases of non-melanoma skin cancer, the number remains high, reaching 450 thousand (INCA, 2020).

In the Amazon, the estimated rate is 23.57, or 35 cases per 100,000 women. In Manaus, capital of the region, where the majority of care takes place, the indicator is 53 cases. (Inca 2020). The cellular changes that lead to cervical cancer are easy to detect during a preventive exam: the Pap smear. Currently, the Unified Health System (SUS) makes the HPV vaccine available free of charge for girls aged 11 to 14 years. Vaccination is the most effective measure to prevent HPV (INCA 2020).

The state of Rondônia implemented 0 RHC in the Basic Hospital and in the Cacoal Hospital between 2012 and 2013, but the Epidemiological Surveillance of the State of Cancer of the National Health Service (Agevisa) explained that it was an agreement between the three parties. Cancer is monitored in Brazilian states through disease registries. Under the agreement, the Hospital

Cancer Registry (RHC) will be implemented in all hospital units that treat the disease (AGEVISA-RO, 2020).

The number of cancer diagnoses in Cacoal is 7.95 per 1000 (one thousand) inhabitants. The largest numbers are women and people over 60 with fair skin. The most detected type was breast cancer, followed by uterine cancer in women and prostate cancer in men. In the treatment of these patients, the combination of chemotherapy and radiotherapy is more recommended (FARIA et al, 2020).

A diagnosis of cancer, like the revelation of any deadly disease, can change families more or less. This is because the family represents a powerful circle in which everyone becomes more connected, whether with the patient or the disease, and the exchange of information and feelings that affect connection and personal bonds. Therefore, while family support is one of the patient's main resources for coping with the disease, family members are also affected when dealing with the emotional needs of the affected members. It is in this sense that cancer can be considered a family disease.

The earlier the cancer is detected and treated, the greater the chance of cure and the better the patient's quality of life. Actions as part of early detection. Note that the goal is to detect precancerous or cancerous lesions while they are still in the organ of origin and before they invade surrounding tissue or other organs. Two strategies used in early detection: early diagnosis, screening. The objective of early diagnosis is to detect the disease as quickly as possible through the symptoms or clinical signs present in the patient.

Chemotherapy is the most common form of cancer treatment. About 60% to 70% of patients require this therapy, which uses chemicals alone or in combination to treat malignancies that may or may not be related to other modalities. Treatment options are based on the patient's tumor type, biological behavior, location, extent of disease, age, and general condition. Currently, this treatment modality is possible thanks to the use of continuous infusion devices (SIQUEIRA et al, 2013).

Continuous infusion devices are unidirectional elastomer pumps. Its main components are: unidirectional elastic balloon, blocker, tube, protective cap, threaded joint and end cap. Can be used for intravenous, epidural or subcutaneous infusions for 12 hours to 7 days. Among its advantages we can mention mobility, ease of occlusion and the fact that the infusion parameters cannot be changed by the user. The disadvantage is the low precision of the equipment and the lack of consistency in the infusion time, that is, the reliability of the drug infusion rate being the same throughout the period is not high.

Currently, chemotherapy is the treatment with the highest curative rate for a variety of tumors (including the most advanced tumors), and it is also what can improve the survival rate of patients with AC. It involves the use of chemical agents that interfere with the processes of cell growth and division, either alone (single chemotherapy) or in combination (multiple chemotherapy), to eliminate tumor cells from the body (OLIVEIRA, 2015).

In the case of treatment, radiotherapy, chemotherapy and surgery, the diagnosis is guided and selected according to the stage of the disease, but all provoke reactions. Chemotherapy, which has the ability to eliminate cancer cells, causes multiple responses due to its mode of action and can have multiple effects on the health of patients receiving chemotherapy, especially the elderly (CIRILO, et al., 2016).

It is also noteworthy that staying at home and living with family members can minimize the discomfort of the disease and treatment, as prolonged or frequent hospitalizations, in addition to extreme discomfort and exhaustion, can pose a threat to these individuals (SIQUEIRA et al., 2013).

Another possible classification type is neoadjuvant chemotherapy, administered before surgery to assess antitumor response and tumor reduction, and adjuvant chemotherapy, administered after surgery to eradicate micrometastases. The routes of administration of chemotherapy are oral, intramuscular, subcutaneous, intravenous (most commonly), intraarterial, intrathecal, intraperitoneal, intrapleural, vesical access and topical (OLIVEIRA, 2015).

For cancer patients, the presence of cancer has a dramatic impact on their daily life, leading to profound changes in their usual lifestyle, in addition to affecting the ability and ability to carry out activities of daily living (SIQUEIRA, 2013).

The adverse effects of chemotherapy are due to the fact that it is not specialized, that is, they are drugs that do not only affect tumor cells. It acts on rapidly dividing cells, mainly hematopoietic tissues, hair follicles, germ cells, lining epithelium of the gastrointestinal tract, among other organs, and may cause side effects (OLIVEIRA, 2015).

At this moment, nurses play an important role in cancer patient care, because by monitoring, directing and implementing actions, they can promote awareness and response to the disease and its treatment, due to a better understanding of their pathology, presentation of effects, treatment, consequences and chances of cure, enabling patients to find more effective ways to tolerate and face all stages of this terrible disease (SIQUEIRA et al., 2013).

Hospitalization can lead to major changes in the patient's lifestyle, distancing him from his social life and personal objects, in addition to increasing the risk of hospital infections. In addition, hospitalization is difficult because it limits the number and rotation of visitors, which makes patients uncomfortable and unpleasant (SIQUEIRA et al., 2013).

It is necessary to become a trained professional, competent in the activities that he performs in order to be able to safely guide towards a humanized and individualized care, go beyond his scientific knowledge and build a willingness on the part of the nurse to listen to the relationship with the patient and tell him about it. your treatment. Effective communication, which provides clear and objective information, offers better options and solutions, is another way for patients to address concerns about the disease and treatment, being essential for quality care (SIQUEIRA et al., 2013).

The treatment brings several side effects to the patient's life, which the nurse must carefully observe, and the entire team is involved in the treatment process. The cancer patient undergoing chemotherapy has many side effects that affect taxes, emotions and physiology. . You will say loss of appetite and dizziness (CUBERTO &, GIGLIO, 2014).

Faced with the impact of a diagnosis and its consequences, the psychologist's role in oncology proposes psychosocial and psychotherapeutic support and shows the potential to help improve the coping and quality of life of patients and their families (SCANNAVINO et al., 2013).

Knowing how to guide and identify doubts and anxieties is fundamental for the performance of the nursing professional. Knowledge added to effectiveness, communication, sincerity and empathy are constructive elements of care that will influence the development of care provided to cancer patients (SIQUEIRA et al., 2013).

The main role of the pharmacist in the oncology pharmacy is to help improve the adequacy of treatment, increase its effectiveness and reduce the incidence of adverse effects and medication errors. The community health work environment is considered less hierarchical than the hospital environment, where many nurses are considered to have greater autonomy and opportunities to use their initiative to develop care. The family is a fundamental factor in coping with the disease and, in addition to maintaining the inherent spirituality and ensuring forms of recreation, it can also serve as a source of support and security. Women with family support are better able to overcome problems, and they use family support as an incentive to seek quick medical care and the possibility of treatment (PANOBIANCO et al., 2012).

Sometimes, patients can be unable to participate in the daily activities that I practice for a long time, leaving them feeling unable to know that, due to this cancer, they will no longer be able to carry out their daily activities and will undergo changes in their living habits. The nurse is responsible for meeting the physical and emotional needs of the patient, such as hygiene and food care, guidance on medication and monitoring of vital signs (TAMBORELLIL et al., 2010).

In the treatment of elderly patients, the tendency of the elderly to respond more strongly to the use of medications should be noted. Nurses must know the pharmacokinetics and pharmacodynamics of medications used for proper administration and be able to identify side effects. By understanding the ingredients of the drugs I use to treat patients, nurses can determine dosage adjustments and what happens to girls during treatment (FERNANDO et al., 2016).

The personal well-being of patients is a right that must be respected by any age group. Caring is a form of interaction that involves dedication, interest, participation and responsibility. In the care team, care can be demonstrated in different ways, such as gestures of affection, posture, look and touch, empathy with the patient, knowing how to listen to the patient's reports of fears regarding the diagnosis of cancer or uncertainties. Including the treatment modality (SIQUERA et al., 2014).

Nursing professionals and underlying cancer patient camps From prevention, diagnosis, treatment and rehabilitation, the nurse must have warm company and pass on the patient's trust and awareness of the teeth that treatments and procedures will be carried out in the best possible way. Help cure or reduce pain in the home of terminally ill patients (LEAL, 2016).

Due to industrialization and the age transition from the young to the elderly population, the Brazilian health service has recognized cancer as a serious public health problem, not only at the national level, but mainly in developed countries. More than 6 billion people die each year in this country, which has one of the highest cancer rates, but is starting to change slightly in developing countries as cancer rates increase (CONCEIÇÃO et al., 2012).

The patient and his family need to remain strong, especially in solidarity. It is important to understand the realities of life of the cancer patient and their family, the patient's history and role within the family, both financially and personally, living conditions, work and even the patient's beliefs to be able to help and be better and ways to provide support (MUNIZ et al., 2012).

Chemotherapy, the mainstay of cancer treatment, has high cure rates, although its side effects on patients often leave the elderly vulnerable.

#### IV. FINAL CONSIDERATIONS

Health professionals, especially those with high exposure to nurses, are essential in any scenario, but nurses play a fundamental role in cancer patients, and even more so in older patients, especially when they receive in the process. Considering that the elderly tend to see the situation as the end, they end up refusing treatment and, most of the time, they do not bother to seek help because they feel that there is no solution.

The most fundamental role of nurses caring for elderly cancer patients is to use empathy and understanding, as well as to minimize fear, distress, anxiety, and other complications of old age.

Considering that nurses are the most active professionals in primary care, the ideal is to always seek care in a totalitarian way, with attention to the details of each patient being essential. Although the present study is a real contributor, there is a need for more research covering other aspects of the topic, such as interviews with patients and professionals in the region, public and private hospitals, care in primary care networks, health, so that it can complement this research and provide a complete source of information for anyone who wants to understand the subject.

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# Evaluation of the Environmental Quality of a Cemetery using the Method of the Peir Matrix - Case Study

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**Keywords**— *Corpses. Impacts. Effluent.*

**Abstract**— *Cemeteries are potential sources of environmental impact because they do not follow the various standards established by CONAMA. Most of them are not supervised or undergo periodic maintenance, being responsible for polluting the soil, subsoil and also reaching numerous groundwater from the areas where they were installed, considerably affecting the health of the local population. The study took place in the várzea cemetery, in the city of Recife, state of Pernambuco. The choice of this potential source of contamination stems from the scarcity of studies on the subject, especially in the State of Pernambuco. Local visits related to local information suggest not only non-compliance with the rules, but also possible pollution and contamination of soil and free aquifer. Therefore, the present research aims to investigate the environmental quality of the Várzea cemetery using the Pressure-State-Impact-Response Matrix (PEIR Matrix). The methodology used was the literature review, on-site visits in order to verify compliance with the legislation as well as the construction of a Matrix, also based on an analysis of soil quality. Considering the data obtained with the particle size analysis, it was verified that the sediments, in the cemetery area, showed predominance of sand grains in the surface layer of the terrain. It was possible to conclude through the matrix that the cemetery presents itself with low environmental quality and may be generating negative environmental impacts of great proportions.*

## I. INTRODUCTION

It is not only during life that the human body undergoes transformations. In fact, with the occurrence of death, the human body decomposes, contributing to pollute the environment (ABIA et al., 2019) and becomes an

ecosystem, composed of arthropods, bacteria, pathogenic microorganisms, and organic matter destroyers.

It occurs that, in some cases, when decomposition starts to occur in places where there is no adequate infrastructure, as well as the absence of hydrogeological studies, it can

generate significant environmental impacts, especially the contamination of water, both surface and underground, by microorganisms that proliferate along the decomposition of bodies (NASCIMENTO, 2020).

Cemeteries, in their early days, were seen as a place to sleep. After numerous problems due to the lack of organization of the places where the bodies were deposited after death, they became necessary, due to the fact that they were places with great potential for environmental impact. When they are not properly maintained. In addition to causing bad smell, the process of saponification of bodies and the flow of water passing through the graves to nearby communities can occur, which can generate serious risks to the health of the population (LINS et al, 2018).

Despite the damage they can cause to the environment, research related to the subject is still scarce. In the studies that could be verified, such as Lins et al (2018) and Pinheiro, et al (2018), the biggest problems pointed out by the researchers were the contamination of soil, air, and groundwater, in addition to non-compliance with the laws in force.

Therefore, the present research aimed to evaluate the environmental quality of the Várzea cemetery using the technique of the Pressure-State-Impact-Response Matrix (PEIR Matrix), where data were obtained through field visits and particle size analysis of the soil.

## II. METHODOLOGY

The research method adopted was the hypothetical-deductive, since a set of information will not be sufficient

to explain a phenomenon. To try to explain the problem, several hypotheses were created, which were tested for its validity. This way if a truth is accepted, it does not mean that it is considered true. It's just a truth that hasn't been distorted yet.

The first hypothesis considered was that being the surface soil with sandy characteristic, the possibility of negative environmental impact in the subsoil is high. The second hypothesis is that the soil has homogeneous and uniform characteristics. The third hypothesis considered is that necrochorum has equal density and viscosities.

Another method also used was the investigative method, aiming to make the deductive method more real where only loco surveys were performed associated with particle size analysis of the soil.

### 2.1 Area of Study

The study area chosen was the Várzea Cemetery, located on Av. Prof. Artur de Sá, s/n, being one of the five municipal cemeteries of Recife, Pernambuco, Brazil, which are administered by the city hall, from the Municipality of Maintenance and Urban Cleaning of Recife (EMLURB).

Founded in 1867, initially as municipal public cemetery of the parish of Várzea, since it was connected to the parish of the neighborhood, from the donation of the land, made by Major José Antônio de Brito Bastos. The cemetery has a total area of 21,700m<sup>2</sup>, distributed in three blocks of catacombs, in which 3,159 tombs are distributed (Figure 1).



Fig.1: Aerial view of várzea cemetery. Source: Googlemaps (2022).

Inside the cemetery it is possible to observe that, in the blocks, although, the shallow pits (coffins placed directly

on the ground) with excavations from 0.6 to 0.8 meters deep, there are also tombs in precast blocks, consisting of

two compartments coated with masonry plates without plaster, which reach the depth of 1.5 meters. In catacomb blocks, tombs comprise drawers coated internally by cement and, for the most part, above the surface of the ground. For the most part, the graves are not perpetual, and there is reuse after a minimum period of two years, when the remains are removed and then proceeded new inumção – the remains are packed in a new container and placed in the lower part of the tomb, while a new coffin is deposited at the top of the tomb.

## 2.2 Surroundings of the cemetery

In general, cemeteries were initially implanted outside the urban perimeters. However, urban sprawl over the years has narrowed the gap between cemeteries, such as Várzea Cemetery. Currently, the surroundings of the cemetery are completely urbanized, including constructions that use part of its wall to make up its buildings.

It is also possible to observe the lack of infrastructure in the residential areas around the cemetery, such as lack of sanitary sewage and regularity in the water supply. The housing units were built without any type of urban planning, given the occurrence of alleys, streets without exit and advance of buildings on the streets, without meeting minimum urban parameters. The residences are mostly low-income, and it is also observed the existence of small commercial units.

## 2.3. The PEIR Matrix

In order to enable the interpretation and analysis of the data in a complete and objective way, a matrix of pressure-state-impact-response (IRP) model indicators was applied.

This methodology made it possible not only to identify, but also to identify the possible negative impacts generated and its consequences on the environment, especially in the vicinity of the locality where the Várzea cemetery is located.

The PEIR Matrix methodology, as carvalho (2020) shows, is a means of research used to evaluate the state of the environment under study, in order to present proposals that may mitigate or avoid environmental impacts that the potentially polluting activity developed in it can cause. The definition of this analysis model is clarified in a synthetic way, but quite assertive. Still according to the author, the matrix of pressure-state-impact-response (IRP) model indicators seeks to establish a logical link between its various components that can be materialized from "cycles", in order to guide the evaluation of the state of the environment, from the factors that exert pressure on natural resources (which can be understood as the "causes" of their current state, which may consist of direct pressures that society exerts on the environment), through the current state of the environment ("effect" in the face of pressures and responses exerted by society) and the impacts of this effect on the environment (consequences arising from the state of the environment), to the responses (reactions) that are produced to address environmental problems in each locality.

Thus, it is possible to understand that the model consists of feedback of your data, to arrive at the necessary answer to solve the problem that was first identified. This feedback can be observed more clearly in Figure 2:

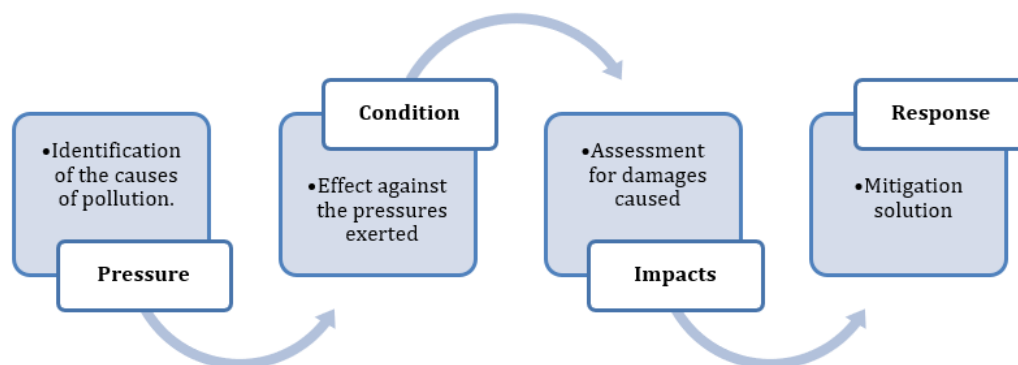


Fig.2: Flow of construction of the PEIR Matrix.

Source: The Authors (2022).

With a matrix of indicators, it is possible to obtain the means to structure the sets of indicators, so as to facilitate their interpretation and thus ensure that all aspects are taken into account, besides being able to help in understanding how different issues are interrelated.

It is worth mentioning that, before the construction of a data matrix itself, it is necessary to carry out field research in such a way that the data necessary for the evaluation of social and environmental impacts are collected. However, the collection of these data cannot be

performed randomly, otherwise the construction of the matrix would be impaired, which, despite presenting a range of data, these same data would not have a correlation, which is at the core of the adopted model. In

this sense, an adapted methodology of Carvalho (2020) was used in his research since it allows the replication of this method in the Várzea cemetery, Pernambuco, Brazil.

Table 1: Description of the indicators observed in the field. Source: Carvalho (2020).

Indicator	Points to note
Pressure Indicators	They should be mainly associated with the assessment of the environmental function, and are also linked to issues related to the functioning of the basic sanitation system;
State Indicators	They are predominantly related to issues relating to the evaluation of sanitary and environmental realities
Impact Indicators	Representative of situations regarding the level of preservation of natural resources and impacts on the population, thus observing a diversity of indicators regarding the classification of environmental dimension conditions
Response Indicators	It refers to the scope of instruments, methodologies and policies that can act on the municipality and, mainly, on the area, in relation to sanitary and environmental functions, in a corrective or preventive manner

## 2.2. Soil Granulometric Analysis

There are two assays for the determination of soil granulometry. In one of them is done the thick and fine sieving. In the other, sedimentation is carried out in distilled water.

- Sieving method: Separating particles up to 0.074 mm.
- Sedimentation method in distilled water: for particles smaller than 0.074. The test can be performed in up to three different ways.
  - Only sieving for granular material.
  - Sedimentation for fine soils.
  - Joint particle size analysis, which comprises both sieving and sedimentation (soils with coarse and fine particles).

These tests were all performed based on the standards NBR 7181 - ABNT - "Soil - Particle Analysis", NBR 5734 - ABNT - "Sieves for testing - Specification" and NBR 6457 - ABNT - "Soil Samples - Preparation for Compaction Tests and Characterization Tests".

## III. RESULTS AND DISCUSSION

### 3.1. Visit *In Loco*

In the on-site visit to the cemetery, it was possible to observe that neither the administration of these necropolises, nor the City of Recife, through the Urban Cleaning Maintenance Company (EMLUB), responsible for its maintenance and administration, comply with environmental legislation, which aims to preserve the environment and avoid the impacts generated by the installation of a cemetery in the urban environment.

It is not that for the installation of a cemetery, especially in urban areas, it is necessary, in addition to the study of environmental impact, the implementation of measures to prevent negative impacts, such as installation of drainage systems and treatment for necrochorum, to avoid soil contamination and, consequently, the proliferation of diseases to the population.

Although the tombs presented in Figures 3 and 4 present apparent good state of conservation, it is possible to identify cracks and cracks, which are capable of releasing necrochorum and gases, thus observing the need for periodic maintenance of the tombs being a way to mitigate the possible damage caused to the environment.



Fig.3: Drawer tomb (osuary). Source: The Authors (2022).

It was possible to verify that, according to Figuras 3 and 4, the construction of tombs and graves in the várzea cemetery did not occur in the correct way, according to what is provided in Article 6 of the resolution of

CONAMA 335/03, which establishes that the tombs must be built with specific material, which does not allow the leakage of liquids and the passage of gases from the decomposition phases of the bodies.

It is notorious that the deposits present structural problems, which can lead to the leakage of necrochorum and gases to the environment, where, according to Santos (2013), it is classified as a secondary physical impact, which are linked to the quality of the materials used in their construction.

Another problem observed was the lack of rainwater drainage system, generating some grooves in the local soil. A similar situation was the subject of a study conducted by Petsch, Monteiro & Bueno (2011) in the Municipal Cemetery of Sussuí, state of Paraná, Brazil, where the erosive processes were identified bringing a series of damages to the site. Through local measurements it was possible to measure differences of a level greater than 20 cm between the graves of the Cemetery of Drowned Ingazeira, Pernambuco, Brazil. In turn, CETESB (1999) states that the perimeter and interior of the cemetery should be provided with an adequate and efficient drainage system, in addition to other devices designed to capture, route, and dispose of rainwater flow safely and prevent endues, flooding and land movements.



*Fig.4: Tomb with masonry perimeter presenting malfunctions. Source: The Authors (2022).*

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### 2.3. Soil Research Analysis

The geological and subsoil analysis was performed based on the information obtained in the literature and local organs. Through information obtained from CPRM (Geological Service of Brazil), ITEP (Technological Institute of Pernambuco) and EMLURB (Urban Maintenance and Cleaning Company of Recife) it was possible to obtain enough data to obtain the PEIR matrix.

The Boa Viagem aquifer, where the Várzea cemetery is established, for example, has a groundwater level close to 6.0 meters, an average thickness of 50 meters in the neighborhoods of Várzea and Cidade Universitária, an average flow rate of 17 m<sup>3</sup>/h and an average specific flow rate of 4.5 m<sup>3</sup>/h/m, data obtained from the CPRM (2003). Through studies conducted by Costa (1998) it was possible to obtain the hydrodynamic parameters related to transmissivity (T), hydraulic conductivity (K) and porosity (ρ) of the Aquifer Boa Viagem, whose mean values correspond, respectively, to 7 X 10<sup>-3</sup> m<sup>2</sup>/s, 1.7 X 10<sup>-4</sup> m/s and 0.10. The author also points out that aquifer is because it is free, has its main recharge from rainwater, in addition to rivers, leaks from sewage networks and losses in the public supply network.

Geotechnical studies carried out by ITEP (2001), inside the várzea cemetery, indicated that the level of the groundwater surface was not reached up to 4.0 meters deep and that the construction of an observation well, manual lye, inside this cemetery, in February 2003, made it possible to determine the level of water in subsurface, which was 6.0 meters deep, confirming Costa (1998).

Through Espíndula (2004), in his master's thesis, it was possible to obtain information in the area around this cemetery, where the occurrence of residential shallow wells is high. In general, they presented depth ranging from 9 to 15 meters and were used, in general, as a complement to the public supply carried out by the Pernambuco Sanitation and Supply Company – COMPESA, occurring less frequently in cases in which such wells are the only source of supply.

After a new local analysis in 2022, there was an increase in the use of shallow wells in the surrounding areas due to the population increase and the water rotation imposed by COMPESA due to the low in the dams. It is notepoint that

when observing the waters, they are still darkened, brackish and with unpleasant odor. According to several authors (MIGLIORINI et al., 1994; MARINHO, 1998; MATOS & PACHECO, 2002) the waters of the groundwater aquifer in cemetery areas may have some of its chemical parameters altered due to contamination from the decomposition of the bodies.

Based on the particle size analysis of the surface soil (considered the most critical – the one that, during visual tactile analysis, found predominance of granular soils), the sands presented percentages ranging from 60 to 93% on the surface. Among the sands, the classification specified from very coarse sand to very fine sand, whose percentages ranged from 0.17 to 30.2%, for very thick sands, and 0.5 to 20%, for very fine sands.

#### 2.4. PEIR Matrix

Thus, with all the information and records obtained, it was possible to assemble the matrix of PEIR para analysis of the ambient quality of the cemetery. Seeking to understand the cause and effect of anthropic actions on the environment will be fundamental for decision-making that can contribute to the orientation of environmental diagnosis and what can be done to prevent and mitigate current and future negative environmental impacts.

The violation of technical standards in the operation and adequacy of cemeteries, lack of supervision, lack of

planning and environmental management, serve as characteristics of the pressures exerted by anthropic activity, factors that can lead to contamination and pollution of the areas where the cemetery is implanted.

The state of the environment, which result from the pressures are release of liquid and gaseous cadaveric effluents, production of solid waste without proper management, burning of bones due to lack of ossary, lack of drainage of rainwater. The impacts are produced on different aspects such as environment, quality of life and economy, which generates negative impacts such as: contamination of surface and underground water bodies and soil, air pollution, spread of diseases, hospital costs, visual pollution, proliferation of vectors of diseases, air pollution, soil erosion and saponification.

The answers are the component of the matrix that corresponds to actions that will mitigate or prevent negative environmental impacts, and that conserve natural resources contributing to the improvement of the quality of life of the local population. They are: Environmental Risk Prevention Program (PPRA), Immediate recovery of graves to prevent leakage of liquids from colliding and treatment of possible gaseous effluents, using, for example, activated carbon, as shown in Table 2.

Table 2: PEIR Matrix for Várzea Cemetery, Recife/PE. Source: The Authors (2022).

PRESSURE	CONDITION	IMPACT	RESPONSE
Non-compliance with the standards determined by CONAMA resolutions.	Depredation of the graves, graves, drawers, and mausoleums of the cemetery. Residences very close to the cemetery.	Pollution of surface and groundwater, causing communicable diseases, causing impacts on public health.	Treatment and conservation of tombs, pits, drawers to prevent the expulsion of contaminant liquid gases, both in the flora and in the local fauna.
Omission of the supervision and management of the City of Recife.	Lack of cleanliness of the pits and non-observance of the minimum distance between them.	Direct and indirect contamination of the environment of those who perform activities in the cemetery and visit the burials.	Build drainage systems for the discharge of necrochorum esum that carries the greatest environmental impact, through the leakage of the tombs and graves of those who were buried.
Absence of environmental studies and training for environmental management.	No drainage of surface and groundwater reaching the groundwater.	Pollution of the tombs through the cracks found. There is a great passage of water bodies, resulting in infectious diseases such as hepatitis "A", typhoid fever, amebas and	Implantation of biodegradable coffins and blankets to contain the leakage of toxic gases and necrochorum, causing infectious diseases.

PRESSURE	CONDITION	IMPACT	RESPONSE
		problems to the population that resides in the surrounding area.	
Lack of maintenance and conservation of the tombs and graves of the cemetery.	Infiltration of the soil, causing contamination of groundwater and surface water due to the cracks of the tombs.	With the shedding of necrochorum, especially in the rainy season, there is contamination of the lenients and, consequently, the spread of infectious diseases, such as hepatitis "A", typhoid fever among others.	Build a correct drainage system for the passage of necrochorum without harming the local population.

The matrix built in this research is like that built in the São Luiz Cemetery, in the municipality of Escada/PE, carried out in the scope of the research by Lins et al (2018). It was not possible to notice the non-compliance with environmental standards, which is the starting point of the negative impacts caused by the cemetery analyzed here.

In the question of the analysis of the "condition", the leakage of liquid effluents (such as necrochorume) was identified. This leak is later identified at the "impact" point of the matrix, where contamination of surface water bodies is identified.

On the "response" point identified in the matrices, although some differences are observed, see the particularities of each cemetery, the common point is the suggestion of the construction of drainage system for effluents that are released into the soil and, consequently, in the groundwater (According to Hypothesis 1) without proper treatment, mitigating the problem of water pollution that will later be used by the population living around the cemetery.

#### IV. FINAL CONSIDERATIONS

Through the present study it was possible to verify that the problems generated by the Várzea cemetery in the locality where it is located, especially about the environmental impact, are due to the lack of application of the norms and guidelines that establish the minimum measures necessary for soil preservation and the surface of such localities.

Although the physical structure, which was the point of analysis of this research, already demonstrates that it is very likely that the environment of that area is contaminated, it is necessary to evaluate more thoroughly the impacts generated, through analysis of the current level

of pollution, especially the soil and groundwater of the cemetery area and its surroundings.

The present research applied the PEIR Matrix, at a time of pandemic, which, despite the difficulties to collect the necessary data, was constructed from the information collected in the cemetery object of our research.

Given its objective, the use of the Pressure-State-Impact-Response (IRP) matrix proved effective in identifying problems and solutions that are capable of, if not completely correcting the problems encountered, significantly reducing the negative impacts generated by Várzea cemetery, Pernambuco, Brazil.

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## Protocol for dilution of standardized anti-infective injectable drugs in the Public Hospital Network of the state of Tocantins

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**Keywords— Medication errors.**

**Abstract—** Antimicrobials act on microorganisms by inhibiting their growth or causing their destruction, and their misuse leads to increased health-related costs. Failures in dispensing and administration mean that the last barriers to patient safety, where errors could be avoided, have been broken. Thus, safe and effective strategies are needed in institutions to ensure health care quality by minimizing the occurrence of medication errors. To develop a dilution protocol to assist health professionals in preparing standard injectable anti-infective drugs in the Public Hospital Network of the State of Tocantins. This is documental, descriptive research, carried out through the analysis of anti-infectious injectable drugs, developed by consulting information from sources such as the

**Medication dilution. Patient Safety**

*Handbook on Injectable Drugs (Trissel), clinical and hospital pharmacy books, as well as laboratory package inserts and pharmaceutical guides. From the 108 standardized anti-infective drugs, 40 injectable drugs were analyzed. Therefore, it is essential to understand the different medication processes, how to develop them, recognize the possible weaknesses, propose measures for their prevention and improve patient safety. The implementation of a protocol of dilution and stability for the administration of injectable anti-infectious drugs is of great importance aiming to minimize the rate of errors related to drug preparation.*

**I. INTRODUCTION**

Antimicrobials are natural or synthetic substances that act on microorganisms by preventing their growth or causing their destruction [1]. Their improper and exacerbated use leads to increased health-related costs, as well as increased microbial resistance. These factors can worsen infectious diseases, increasing the number of adverse reactions and hospitalization times [2, 3].

A medication error is determined as any avoidable event that may cause or induce inappropriate use of medication, or harm the patient, at any stage of drug therapy. Medication errors are one of the most common failures in health care [4]. The identification of these errors can assist in the development of new practices that ensure the appropriate and rational use of medicines, continuously improving patient safety [5].

The rational use of antimicrobials should be guaranteed, as the administration of a dose below or above the prescribed or recommended one may impair the outcome of therapy, causing ineffectiveness or toxicity of the treatment, respectively. Furthermore, antibiotics act on invading bacterial cells and also alter the host's natural microbiota, which represents an additional risk for the hospital, due to the viability of selecting resistant bacteria [6].

The medication practice in the hospital environment can be determined as a complex system. With several indispensable processes, independent and constituted by a multidisciplinary team that includes professionals from different areas of knowledge (physicians, pharmacy, and nursing staff), having a common goal, the provision of health care to patients with quality, efficacy, and safety [7].

As for drug preparation, where dilution is performed, scientific principles must be applied, ensuring the expected therapeutic result. Therefore, it is necessary to know what to dilute, the amount to be administered in the peripheral and/or central venous access, how long the administration can be prepared, and under which environmental conditions (light, temperature, and humidity) [8,9].

Several segments are concerned about establishing activities that collaborate with the rational use of medications in the hospital environment. In this context, a protocol for drug dilution can help prepare and administer injectable drugs, with information accessible to all involved [10].

Failures in the form of dispensing and administration mean that the last barriers to patient safety, where errors could be avoided, have been broken. Therefore, safe and effective strategies are needed in institutions to ensure health care quality by minimizing the occurrence of medication errors [11].

Considering the need for a tool aimed at patient safety, this work aimed to develop a dilution protocol to assist health professionals in preparing standard injectable anti-infective drugs in the Public Hospital Network of the State of Tocantins.

**II. MATERIALS AND METHODS**

This is documental, descriptive research, carried out through the identification and analysis of the standardized anti-infective injectable drugs in the Public Hospital Network of the State of Tocantins (Portaria/SES/GASEC Nº 425, from August 19, 2020) [12].

In this list of hospital drugs, from the 665 items divided into 18 therapeutic groups, we used those from group 5 - Anti-infectious Diseases, which includes 40 injectable drugs. Only the injectable anti-infective drugs were included in the study, excluding the other pharmaceutical forms. The table was developed by consulting technical-scientific information in sources such as Handbook on Injectable Drugs, 15th edition (Trissel), clinical and hospital pharmacy books, as well as laboratory package inserts and pharmaceutical guides. The research data were grouped and tabulated using the Word for Windows® program tool, with the outcome being a didactic-institutional material for a quick consultation. There was no need to submit to the Research Ethics Committee, resolution of the CNS (466/2012) because this is research

whose information was obtained in materials already published and available in the literature.

### III. RESULTS AND DISCUSSION

Of the 108 standardized anti-infective drugs, 40 injectable drugs were analyzed. The analyzed data were inserted into a table, which presents the active ingredient, route of administration, reconstitution, and dilution, stability after reconstitution and dilution, infusion time, and additional observations with such drugs. This material, represented in Chart I, was developed in a way that it can be updated, containing the procedures and the sources of each information obtained.

on the importance of the work or suggest applications and extensions.

Given the results, several studies have detected that the administration of antibiotics requires strict control as to the timing and appropriate dilutions in order not to compromise their stability and selection of resistant bacterial strains. Adverse events in inadequate administration may occur, affecting the safety and quality of the patient's medication. The administration of the correct dose, concentration, and infusion time of an antibiotic is largely dependent on the entire multidisciplinary team at the hospital [20,21,22,23].

Conducted a study in a university hospital, where he asked nurses to write down doubts presented by nursing assistants and technicians, regarding the preparation and administration of medications and evidenced that most (40.4%) were related to dilution [24]. In 2020, a study found that the higher doses and volumes of diluents can influence the form of preparation and administration of the medication and lead to therapeutic failure [20].

In research related to antimicrobial dilution errors, 416 prescriptions that needed to be diluted were examined, and it was found that the degree of dilution was not specified in 39.7% of the drugs, and among those prescribed, 57.1% were not correct. Therefore, when dilution is not performed correctly, it can cause adverse consequences to the patient, such as incompatibilities and increased treatment time. Thus, the dilution must occur precisely, minimizing risks for the patient and the hospital community [25].

In a hospital analysis about prescription errors of injectable drugs, 1,386 prescriptions were examined, of these, 184 errors were found, 30.43% correspond to prescriptions that did not contain any observation regarding the time of drug infusion. The identified dilution errors showed a rate of 14.13%, of these, 10.87% are related to incorrect dilution, causing therapeutic ineffectiveness, loss of stability,

besides risks to the patient's health. It was also identified prescriptions with the omission of data on the dilution in 3.26%, leading to error in the preparation and administration of medicines [26].

Thus, dilution errors can lead to therapeutic failure, increased costs for institutions, unwanted reactions in patients, and affect the quality of care [25].

As for the infusion speed of drugs, it must be observed and precisely performed, because the administration time is related to classic adverse reactions, such as the "red man syndrome", which results from a rapid infusion of vancomycin. It is therefore fundamental to determine the infusion rate in the prescription, considering the best scientific evidence available, preventing the occurrence of preventable adverse events [27].

In another study, 3,931 prescriptions were analyzed. After checking the pharmaceutical interventions, 16 types of errors were identified, such as illegible prescriptions (6.6%), lack of information such as prescriptions without dose (18.2%) and absence of route of administration (7.2%), as well as errors related to dilution and/or time of drug infusion were found with 5.3% of cases [28]

A study examined 79 prescriptions for antimicrobials, and regarding the errors in prescriptions, it was verified that most of them had the absence of the route of administration (92.4%), followed by the absence of posology (51.9%), absence of dose (49.4%), and contraindicated abbreviation (40.5%) [29]. Reinforcing the need for greater awareness of prescribing professionals and the participation of pharmacists in the process of reviewing prescriptions before dispensing.

Although the medicine is safe in its intrinsic sense. This is not enough; it is necessary to ensure safety in its use process [30]. Thus, to deal with the problem of medication errors among hospitals, it is essential to understand the different medication processes, how they develop and recognize possible weaknesses, to propose measures for their prevention and improve patient safety [31]

Chart I - Dilution protocol for injectable anti-infective drugs standardized in the Tocantins State Hospital Network.

ACTIVE INGREDIENT AND PRESENTATION	WAY OF ADM.	REBUILDING / STABILITY	DILUTION/STABILITY	INFUSION TIME	REMARKS ADDITIONALS	REF.
ACYCLOVIR 250MG CYLINDER BOTTLE	EV	500mg - 10mL AD 1g - 20ml AD 12h TA (do not refrigerate)	100ml - SF 0.9%, SG 5%, SRL 24h TA	1h (slowly)	Rapid IV administration and other routes should be avoided.	[13]
AMICACIN SOL. INJETABLE 50MG/ML - 2ml 250MG/ML - 2ml	EV	-	100-200ml 0.9% SF, 5% SG 24h TA or 48h Under Ref.	30 - 60min	Direct EV does not apply. Maximum dose: 1.5g/day.	[13, 14, 15, 16]
	IM	-	-	-	-	
AMPICILLIN 500MG and 1G CYLINDER BOTTLE	EV	500mg - 5ml AD 1g - 7.4ml AD 1h TA or 4h Under Ref.	50 - 100ml 0.9% SF 8h TA or 24h Under Ref.	Direct EV: 3 - 5min (500mg) 10 - 15min (> 500mg) Intermittent: 15 - 30min	Reduced stability when used in SG. Maximum dose: 12g/day.	[13]
	IM	2 - 3ml (Deep)	-	-	-	
AMPICILLIN 1g + SULBACTAM 500mg AMPICILLIN 2g + SULBACTAM 1g vial	EV	3.2ml (1.5g) and 6.4ml (3g) AD 8h TA or 72h Under Ref.	50 - 100ml SF 0.9%/ 8h TA	Direct EV: 10 - 15min Intermittent: 15 - 30min	Reduced stability when used in SG. In SG 5%: 2h RT or 4h under ref. Maximum dose: 12g/day.	[13,15,1 6,17]
	IM	3.2ml (1.5g) and 6.4ml (3g) AD, Lidocaine 0.5 or 2% Must be used within 1h	-	-	-	
AMPHOTERICIN B 50MG VIAL-AMP	EV	10ml AD or proper diluent 24h AT or 7 days Under Ref. and protected light	490ml SG 5%. Immediate use	2h - 6h	SF or preservatives should not be used (precipitation). For administration use a protective pouch and light-sensitive	[13, 18]

					equipment. Store FA intact under ref. and protected from light.	
AMPHOTERICIN B 50MG LIPOSOMAL CYLINDER BOTTLE	EV	12ml AD 24h Under Ref. protected from light	25 to 250ml SG 5% (1:1 to 1:19 from reconstituted) 6h Under Ref.	2h	Incompatible with DES and electrolytes. The end of the syringe should be attached to the 5-micron filter supplied with the medication to aspirate the contents of the vial and insert it into the bag.	[13, 15, 16, 17, 18]

ACTIVE INGREDIENT AND PRESENTATION	WAY OF ADM.	REBUILDING / STABILITY	DILUTION/STABILITY	INFUSION TIME	REMARKS ADDITIONALS	REF.
ANIDULAFUNGIN 100MG VIAL-AMP	EV	30ml of proprietary diluent 1h Under Ref.	SF 0.9% or SG 5% - Attack dose on day 1 200mg/day diluted in 200ml After 100mg/day dilute to 100ml 24h Under Ref.	90min	-	[15, 18]
BENZYL PENICILLIN BENZATHINE VIAL 600,000IU and 1,200,000IU	IM	2 - 4ml AD Immediate use	-	-	Administration exclusively by deep IM route	[16]
BENZYL PENICILLIN POTASSIUM AMPOULE 1,000,000IU and 5,000,000IU	EV	2 - 10ml AD 24h TA or 7 days Under Ref. 6-5 T	50 - 100ml 0.9% SS, 5% SG 24h TA or Under Ref.	30 - 60min	Final volume after reconstitution is 12 ml (5,000,000 IU)	[13, 15, 18, 19]
	IM	3.5ml AD	-	-	-	

		24h TA or 7 days Under Ref.				
BENZYL PENICILLIN POTASSIUM 100,000UI+ PENICILLIN PROCAINATE 300,000UI VIAL-AMP	IM	2ml AD Immediate use	-	-	Deep and slow IM use	[15]
CEPHALOTHIN 1G CYLINDER BOTTLE	EV	10ml AD 12h TA or 96h Under Ref.	100ml 0.9% SF, 5% SG 12h TA or 7 days Under Ref.	Direct EV: 3 - 5min Intermittent: 30 - 60min	-	[14,18]
	IM	5ml AD	-	-	-	[19]
CEPHAZOLINE 1G CYLINDER BOTTLE	EV	2.5ml AD 24h TA or 10 days Under Ref.	Direct IV: 10ml AD. IV intermittent: 50 - 100ml SF 0.9%, SG 5%. 12h TA or 24h Under Ref. (protected from light)	Direct EV: Slowly 3 - 5min Intermittent: 30 -60min	Store the bottles in AT protected from light. IV: do not mix with other medication. Maximum dose: 6g/day.	[13,14,1 516, 17]
	IM	2.5 ml Lidocaine 0.5%, AD	-	-	-	
CEFEPIMA 1G and 2G CYLINDER BOTTLE	EV	. 5 - 10ml AD, SF 0.9% or SG 5% 24h TA or 7 days Under Ref.	50 - 100ml SF 0.9% or SG5%. 24h TA or 7 days Under Ref.	Direct EV: 3 - 5min Intermittent: 20 - 30min	Store intact vials at 2°C to 25°C protected from light.	[13,15,1 7]
	IM	Doses up to 1g (volume < 3.1ml) AD, SS 0.9%, SG5%, lidocaine 0.5 or 1% 24h TA	-	-	The maximum dose for the IM route is 1g at a single site. A maximum IM dose of 2g (6.2ml), should be administered at two sites.	

ACTIVE INGREDIENT AND PRESENTATION	WAY OF ADM.	REBUILDING / STABILITY	DILUTION/STABILITY	INFUSION TIME	REMARKS ADDITIONALS	REF.
CEFOTAXIME 1G CYLINDER BOTTLE	EV	10ml AD 24h TA or 7 days Under Ref.	50 - 100ml 0.9% SS, 5% SG 24h TA or 5 days Under Ref.	Direct EV: 3-5min Intermittent: 20-30min	-	[13]
	IM	3ml AD or Lidocaine 1% S/V 12h TA or 7 days Under Ref.	-	-	-	
CEFTAZIDIME 1G CYLINDER BOTTLE	EV	10ml AD 24h TA or 7 days Under Ref.	50 - 100ml SF 0.9%, SG 5% 24h RT or 7 days Under Ref.	Direct EV: 3-5min Intermittent: 15-30min	Reconstitution generates some carbon dioxide bubbles, but this is eliminated in 1 to 2min. Reconstituted solutions range from light yellow to amber. Maximum dose: 6g/day.	[13,15,17]
	IM	3ml AD or lidocaine 0.5-1.0% S/V 24 TA or 7 days Under Ref.	-	-	-	
CEFTAZIDIME 2000MG + AVIBACTAM 500MG POWDER FOR SOLUTION FOR INFUSION VIAL	EV	10ml AD Immediate use	100ml SF 0,9% , SG 5%, RL 12h TA or 24h Under Ref.	2h	It should be stored in TA and protected from light.	[17]
CEFTAROLINE FOSAMILA 600MG POWDER FOR SOLUTION FOR INFUSION VIAL	EV	20ml AD 6h TA or 24h Under Ref.	250ml 0.9% SF, 5% SG 6h TA or 24h Under Ref.	1h	Store at 2 to 8°C.	[17,18]
CEFTRIAZONE IV 500 MG and 1G Cylindrical Bottle	EV	5ml (500mg) and 10ml (1g) AD IV. Direct 10-20ml of saline solution 2 days TA or 10 days Under	50-100ml SF 0.9%, SG5%. 24h TA or 3 days Under Ref.	Direct EV: 2-4min Intermittent: 15-30min	Store at RT protected from light. After reconstitution, normal exposure to light is permitted. Incompatible with	[13,17,18]



		Ref.			calcium-containing solutions such as ringer and ringer lactate.	
CEFTRIAZONE IM 500MG VIAL-AMP	IM	3.6ml AD or lidocaine 1% S/V 6h TA or 24h Under Ref.	-	-	-	[15,17]
CEFUROXIME 750MG VIAL-AMP	EV	8.3ml AD 24h TA or 48h Under Ref.	50-100ml SF 0.9%, SG 5% 24h RT or 7 days Under Ref.	Direct EV: 3-5min Intermittent: 15-60min	It should be protected from light. It should not be mixed with sodium bicarbonate or aminoglycosides.	[13,17]
	IM	3ml AD 24h TA or 48h Under Ref.	-	-	-	

ACTIVE INGREDIENT AND PRESENTATION	WAY OF ADM.	REBUILDING / STABILITY	DILUTION/STABILITY	INFUSION TIME	REMARKS ADDITIONALS	REF.
CIPROFLOXACIN 2MG/ML SOLUTION INJECTABLE 100ML POUCH	EV	-	-	60min	Infusion should be slow, in a large-caliber vein, to minimize patient discomfort and reduce the risk of venous irritation. A light-sensitive infusion set is not required.	[13]
CLARITHROMYCIN 500MG VIAL-AMP	EV	10ml AD 24h TA or 48h Under Ref.	250ml 0.9% SF, 5% SG 6h TA or 48h Under Ref.	60min	It should not be administered by direct IM and IV. It should be protected from light.	[13,16, 17,18]

CLINDAMYCIN 150MG/ML SOLUTION INJECTABLE 4ML AMPOULE	EV	-	Doses below 50mg - 50ml, and doses of 900mg or more - 100ml 0.9% SS, 5% SG or RL 24h TA	Intermittent: 10-60min	-	[13,15, 17]
	IM	Deep	-	-	IM - Do not dose > 600mg.	
CHLORAMPHENICOL 1G CYLINDER BOTTLE	EV	10ml AD 30 days AT (protected from light)	50-100ml 0.9% SS, 5% SS, RL 24h RT or under Ref.	Direct EV: 1min Flashing: 30min	After reconstitution discard the solution if it becomes turbid.	[13]
ERTAPENEM 1G CYLINDER BOTTLE	EV	10ml AD or SF 0.9%. (Dilute immediately)	50ml SF 0.9% 6h TA or 24h Under Ref. (Use within 4 hours of removal from refrigeration)	30min	Do not dilute in 5% SG.	[13,17]
	IM	3.2ml lidocaine 1% S/V (Administer within 1h)	-	-	-	
FLUCONAZOLE 2MG/ML SOLUTION INJECTABLE 100 ML POUCH	EV	-	-	1-2h	Store in RT, protected from direct light. Does not require a light-sensitive infusion line.	[13,16, 17]
GANCICLOVIR 500MG LYOPHILUS POWDER VIAL	EV	10ml AD 12h TA (do not refrigerate due to possible precipitation)	100ml 0.9% SF, 5% SG 24h AT and 48h Under Ref.	60min	Photosensitive. Handle with caution (teratogenic and carcinogenic potential). Do not mix with other IV drugs.	[15,16]

ACTIVE INGREDIENT AND PRESENTATION	WAY OF ADM.	REBUILDING / STABILITY	DILUTION/STABILITY	INFUSION TIME	REMARKS ADDITIONALS	REF.
GENTAMICIN SOLUTION INJECTABLE AMPOULE	EV	-	50-200ml SF, SG 5%. 2h TA	30 min-2 h	Administer with an interval of 1-2h with penicillins and 1h	[13,17,1 8]

20MG/ML-1ml 40MG/ML-1ml 40MG/ML-2ml	IM	Deep	-	-	with cephalosporins, due to physical inactivation.	
IMIPENEM 500MG + CILASTATIN 500 MG CYLINDER BOTTLE	EV	10ml 0.9% SF or 5% SG 4h TA or 24h Under Ref.	100ml - SF 0.9%, SG 5% 4h TA or 24h Under Ref.	20-30min	It should never be reconstituted with diluents containing lactate. Incompatible with sterile water for injection. Maximum dose: 4g/day.	[13,15]
	IM	2ml Lidocaine 1% S/V Use within 1h	-	-	-	
LEVOFLOXACIN 5MG/ML SOLUTION FOR INJECTION 100 ML POUCH	EV	-	-	At least 60min, doses of 750mg should be infused over 90min	It should not be administered by any other route, as well as in bolus. Store in AT and protected from light. Maximum dose: 750mg/day.	[13]
LINEZOLID 2MG/ML SOLUTION INJECTABLE 300 ML POUCH	EV	-	-	30min-2h	Store in AT and protected from light. The packaging should be kept in its protective wrapper until the moment of use. Maximum dose: 600mg Ev every 12 hours.	[15,16,17]
MEROPENEM 500MG and 1G Cylindrical Bottle	EV	10ml (500mg) and 20ml (1g) AD 2h TA or 12h Under Ref.	100ml - SF 0.9%, SG 5% 2h TA or 18h Under Ref (SF) 1h TA or 8h Under Ref (SG)	Direct EV: 3-5min Intermittent: 15-30min	After adding the diluent, shake to dissolve and let stand until the solution clears.	[13,16,17]
METRONIDAZOLE 5MG/ML SOLUTION INJECTABLE 100	EV	-	-	30min-1h	Store in AT and protected from light.	[13]

ML POUCH					Do not refrigerate (crystal formation). Maximum dose: 4g/day.	
MICAFUNGIN 50MG CYLINDER BOTTLE	EV	5ml 0.9% SF or 5% SG 24h TA	100ml - SF 0.9%, SG 5% 24h AT (protected from light)	60min	No light-sensitive equipment is required.	[13,16,18]

ACTIVE INGREDIENT AND PRESENTATION	WAY OF ADM.	REBUILDING / STABILITY	DILUTION/STABILITY	INFUSION TIME	REMARKS ADDITIONALS	REF.
OXACILLIN 500MG CYLINDER BOTTLE	EV	5ml AD or SF 0.9%. 3 days TA or 7 days Under Ref.	Direct: 500mg/5ml SF 0.9%, SG 5% Intermittent: 50-100ml of SS 0.9% or SS 5% 24h TA	Direct EV: 10min Intermittent: 15-30min	Caution in the elderly, as thrombophlebitis may occur.	[15,16,18]
	IM	3ml AD or SF 0.9%.	-	-	-	
PIPERACILLIN 4 G + TAZOBACTAM 500 MG VIAL	EV	20ml 0.9% SF or 5% SG 24h TA or 48h Under Ref.	50-150ml SF 0.9% or SG 5% 24h AT	30min	Incompatible with Ringer lactate.	[13,17,18]
POLYMYXIN B 500,000UI VIAL-AMPOULE	EV	10ml SG 5% or AD 72h Under Ref.	500,000IU added to 300- 500ML SG 5%. 24h Under Ref.	60-90min	The vials should be stored in AT and protected from light.	[13,15,16,17]
	IM	2.0ML sterile water for injection, 0.9% SF or 1% procaine	-	-	IM administration is very painful and should be avoided.	
SULFAMETHOXAZOLE 80MG/ML +TRIMETHOPRIM 16MG/ML 5 ML AMPOULE	EV	-	125ml SG 5%; in case of hydric restriction: 75ml SG 5% 125 ml: 6h RT and 75ml 2h	60-90min	Do not dilute in SF. Do not refrigerate.	[13,16,17,18]

			RT			
TEICoplanin 200MG VIAL-AMP	EV	3 ml AD 24h Under Ref.	100ml 0.9% SF, 5% SG 24h TA	Direct EV: 3-5min (10ml) Intermittent: 30min	-	[13,15,18]
	IM	3ml AD	-	-	-	[17]
TIGECYCLINE 50MG LYOPHILUS POWDER VIAL	EV	5.3ml 0.9% SF 6h TA	100ml 0.9% SF, 5% SG 24h TA or 45h Under Ref.	30-60min	-	[13,15,16]
VANCOMYCIN 500MG VIAL-AMP	EV	10ml AD 24h TA or 14 days Under Ref.	100ml 0.9% SF or 5% SG 24h TA or 14 days Under Ref.	1h	Rapid infusion of vancomycin can cause red man syndrome.	[13,15,16,18]

AD (Distilled Water), Ref (Reference), SF (Physiological Serum), SG (Glucose Serum), Under Ref (Under Refrigeration), RT (Room Temperature).

In his study that prescribers play a considerable role in the progress of rational use of medicines. So that their analysis in the prescription contributes to quality in therapy, an important step that should be performed by everyone involved with the patient's treatment, such as nurses, pharmacists, among others [32].

Thus, the contribution of hospital pharmacies to infection control in the hospital environment is extremely relevant. One of their main activities is to promote the rational use of antimicrobials, as well as to develop plans, preventive and educational measures in this area [33,34]. Also states that these measures, including clinical guidelines, professional interventions, and recommendations, are of utmost importance [35].

In his work, believes that the pharmacist can formulate measures to avoid the misuse of antimicrobials, high rates of hospital infection, prolonged mortality and length of hospital stay, and situations that can worsen the financial situation of hospitals and the population throughout the country's health system [36]. Therefore, the rational use of antibiotics is essential, not only for patients but also for health professionals and managers [37].

Thus, the pharmaceutical professional in the healthcare system represents one of the last opportunities to identify, correct or reduce possible errors associated with therapy. This professional is at the interface between drug distribution and use and can be considered a key player in quality assurance and medical care [38,39].

#### IV. CONCLUSION

In conclusion, the implementation of a dilution and stability protocol for the administration of injectable anti-infective drugs is of great importance to minimize the rate of errors related to drug preparation. It is a preventive measure, although simple, aimed at patient safety.

It is also worth mentioning the importance of the pharmacist and the other health professionals in conducting the appropriate pharmacotherapy for the patient, considering that this information must be followed carefully so that the patient receives adequate and safe treatment, one of the purposes of this tool.

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# Environmental Engineer Profile: Active Learning in Engineering Education

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**Keywords—** active methodologies,  
engineering education, engineering teaching.

**Abstract—** Several discussions have been raised in higher education institutions for the formation of the environmental engineering graduate profile to fulfill the innovations of Industry 4.0 and the tripod of sustainability, required by the labor market. The agencies responsible for the management of engineering courses have established a series of changes in the teaching plans of the curricula of engineering courses in Brazil so that universities can attend the contemporary trends in the global market. The aim of this study is to identify the profile of the egress of the environmental engineering course at a public Brazilian university, verifying the impressions and demands of this public about their professional training; investigating the demands and the constitution of the professional profile determined by companies, in order to compare what the educational institution is dealing with in the curricular parameters versus what the market is demanding; raising the demands of the boards for engineering curricula updates and, finally, verifying if the parameters determined as requirements of the engineering boards are being fulfilled by the university under study. The results indicate that the graduate profile not only brings evidence of how the university has been acting in the competencies and skills in engineering courses. It was also found that active methodologies have a significant role to perform in the teaching-learning of the new engineering education requirements. We conclude that the skills and competencies focused on economic, social, environmental, and humanistic issues complete the profile of the environmental engineering graduate in the modern times.

## I. INTRODUCTION

The importance of the many industry changes on the application and development of technological solutions in the face of industrial paradigms is evident over the last two hundred years of history. The fourth industrial revolution brought with it a focus on digitalization. The tools brought by digitalization have optimized the information exchange time in many production and service processes. This revolution also brought with it a greater autonomy in face

of the new challenges for the survival of companies in an extremely competitive and global context, with its need for social and environmental responsibility, in compliance with the norms and regulations that these companies fit into. It is a set of technologies that allow the fusion of the physical, digital, and biological world [1]. The main technologies involved are additive manufacturing (3D); artificial intelligence (AI); the Internet of Things (IoT);



synthetic biology (SynBio); and cyber-physical systems (CPS) [1].

The changes caused by the implementation of Industry 4.0 also involve an education that addresses new methodologies for the stimulation of students for active learning (learning from practical experience, by trial and error in a methodical way) [2]. These methodologies enable students to solve problems and propose solutions based on the observation of the real world, interconnecting the university and labor market, reconciling, and creating a new autonomous style of learning.

This paradigm break occurs when the learner becomes responsible for his learning autonomously and efficiently, in response to the needs of the current issues of engineering and industry [3]. One of the active learning methodologies that can be employed is Problem or Project Based Learning – PBL, addressing themes covering environmental, economic, and social issues. The activity thus allows working with the fundamental elements of sustainability, as brought by the triple bottom line and Industry 4.0.

The United Nations - UN and its partners in Brazil have set 17 goals and targets for sustainable development: poverty eradication; hunger eradication; health and well-being; quality education; gender equality; clean water and sanitation; clean and affordable energy; decent work and economic growth; industry; innovation and infrastructure; reduction of inequalities; sustainable cities and communities; responsible consumption and production; decisive action against global climate change; preservation of life on water and life on land; peace, justice, and effective institutions; development of partnerships and the means of implementation of sustainable development programs [4, 5]. These goals and targets aim to stimulate in the coming years a better and sustainable world for all. All these sustainable development goals are determined by the UN.

Higher education plays a key role in the transition to the fourth industrial revolution (4RI) [3]. However, current higher education programs still carry a model based on meeting the needs of previous industrial revolutions, whose demands were also different in terms of demographics, health, literacy levels, social inequality, and climate change.

The changes made in higher education to conform to the 4RI have been discussed by the institutes and their education bodies for their implementation in the various curricular structures, with an emphasis on engineering.

The general concept of 4RI is based on the advance of the productive-industrial process and its relationship with the advanced technologies, such as 3D; AI; IOT; SynBio,

and CPS [3]. The changes caused by the implementation of 4RI involve, besides the technologies involved, teaching, in general, with new pedagogical practices that encourage students to learn actively [2]. With the new technological changes of this revolution, as well as the demands for professionals who know how to deal with these technologies, universities are forced to update their curricula of undergraduate engineering courses to meet the demands of the labor market and establish the profile of the graduate student of each course, according to the demands of the modern times.

The integration between the problem proposed to the student and the practice found in the industry is a key point for Problem Based Learning (PBL) applied to engineering learning. The integration of PBL with industry problems also provides conditions for students to develop interpersonal and self-learning skills [2]. In this respect, the right educational approach to teaching and learning by PBL improves the ability of students to acquire and apply knowledge with problems from real-life situations.

The impacts of sustainability on 4RI are not yet fully known [5]. They are also a challenge in the organization of the labor market [6] and consequently for a new curricular structure of higher education, especially in engineering. Engineering undergraduate courses in Brazil are regulated by CNE/CES 11 resolution of March 11, 2002 [7]. The National Curriculum Guidelines for Undergraduate Education in Engineering - DCNs define the profile of the graduate they should create while considering a holistic and humanistic educational approach.

The national curricular guidelines for undergraduate engineering courses (DCNs for Engineering) have highlighted the importance of reformulating and updating the curriculum to meet future demands, that is, to prepare new engineers for the needs and demands of the market within the context of the 4RI and the competitiveness with the international market.

Therefore, the education of engineers must be rethought, not only in terms of disciplinary adaptations but also in its teaching practices. In this sense, there is, on one hand, a concern with training according to an effective curriculum and, on the other hand, a productive sector that "finds it difficult to recruit qualified workers to work in the engineering knowledge frontier" [7].

For this segment, the expectation demands more complete professionals, in the sense that they are better prepared for the reality of the market. Besides the technical knowledge of the area, the directives point to the need of working on skills and competencies in the formation of engineers, preparing them with other kinds of knowledge

such as leadership; teamwork; planning; strategic management; and learning autonomously.

The graduate profile must be formatted in accordance with the professional profile required by companies, which includes technical and behavioral qualifications.

Competence is understood as the set of skills associated with knowing how to do, knowing how to act within a specific context, based on the knowledge obtained during the course. For example, all the knowledge needed for a specific profession, in the case of this study, the competencies focused on environmental engineering. Skills, on the other hand, refer to abilities learned through training, classes, experience, or observation.

However, it is not integrated into a context. For example, the learner may have the ability to use language to express his ideas in writing, but he may not necessarily have the competence to use this skill to draft a technical report in his area of expertise [8, 9].

Breaking paradigms, in terms of the use of active learning methodologies, helps the "teaching-learning process more positively and effectively, because they favor the participation of the student and contribute to his metacognition since it makes him reflect on his own way of learning" [10].

However, to achieve this goal it is "necessary to readjust the engineering curricula and their pedagogical course plans (PPCs), as well as a better receptivity of both teachers and students" to the new learning technologies.

The objective of this study is to evaluate the graduate profile of the environmental engineering course at a public Brazilian university, using the survey method, through the collection and categorical analysis of the graduates' opinions and reports about the labor market in this field and in the course, as well as to investigate whether the parameters of the requirements of the engineering councils are being met by the university under study.

## II. INDUSTRY 4.0 REQUIREMENTS

It is known that, currently, because of technological advances, the search for more complex, efficient, and high-quality products, the industry, known as 4RI, has directed the market. It has forced the university institutions to promote structural changes that meet this scenario of the industrial world, in which innovative technology is associated with the secure use of the Internet in the transit of digital information [11].

This need for a change in paradigms is also noticeable by the students in this research, who observe, upon finishing university, huge differences between what the

school has taught them and what the market demands from them. 4RI brings a new paradigm that promises to redefine the map of industries' production systems [11].

The need to invest in human capital is well known for several reasons [3]. One is concerning higher education in responding to the demands of the automation and 4RI economy.

Although 4RI is intended to generate inclusive benefits with new jobs in the market, there is also concern about the emergence of some negative externalities and socioeconomic problems such as the extinction of traditional labor [12].

The impacts in social terms are related to the replacement of the workforce by machines, making less-skilled jobs scarcer in the future and increasing the number of unemployed, depending on the level of economic development or the speed of transfer of jobs from the industrial to the services sector in each country. In economic terms, 4RI can generate major impacts on several macroeconomic variables, such as gross domestic product (GDP), investment, employment, consumption, and inflation.

The improvement of skills and abilities are demands from the labor market, as 4RI imposes on industries and their professionals a better qualification. In this way, one can preserve jobs, adapt to recent technologies and organizational changes. Consequently, there is intense pressure for greater access to higher and quality education [11].

The three main competencies based on the challenges imposed by the fourth revolution are (i) the functional, understood as those to meet the technical and professional needs for task performance; (ii) the behavioral, skills intrinsic to the individual himself and (iii) social, the ability of individuals to relate in a group.

The big challenge, therefore, is how to extend learning and innovation into the workplace. Competencies and skills, in this context, need to be coupled with educational redesign to aggregate public, private, and scientific interests in response to 4RI.

The challenges of 4RI sustainability are related to economic, social, and environmental aspects, and not only to the profit of the production activity [4, 11]. An environmental sustainability model must, at a minimum, involve the rational allocation of natural resources, the minimization of waste, or the proper treatment and disposal of such waste. In other terms, the rate of exploitation of natural resources should not exceed the rate of regeneration, just as the rate of waste generation should

not exceed the absorption capacity of the biosphere and the depletion of non-renewable resources [13].

On the other hand, while the current scenario is full of complex global environmental challenges, 4RI arises from the union between the availability of technological digital innovation and consumer demand for high-quality and differentiated products. Even though the 4RI principle is not focused on providing solutions to the ecological problems faced by production, but on increasing productivity, revenue growth and competitiveness have also dealt with the need to produce within environmental constraints geared towards sustainability, considering a reasonable environmental budget, which must be within the demands of contemporary society [5].

However, it is important to investigate how 4RI affects environmental sustainability, as despite its potential benefits, these may be limited by technological infrastructure [14]. Digital technologies are also experiencing global environmental pressure related to the growing trend in energy demand and the urgency of adopting low-carbon energy systems [15, 16].

Moreover, although not unanimous, some academic studies have shown that producing in an environmentally initiative-taking manner is not synonymous with higher expenses, as there are also benefits and competitive advantages related to early environmental activities [16, 17, 18].

The implementation of 4RI impacts the Triple Bottom Line (3BL or TBL). 3BL states that organizations must go beyond economic results, not just focus on direct profits. From this vision, the results must be thought of by three main factors: social, environmental, and economic.

The first factor encompasses the satisfaction and quality of life of the people who are directly or indirectly linked to the company, such as employees and stakeholders.

The second factor concerns environmentally responsible and sustainable actions, such as the use of renewable energy or the appropriate use and recycling of materials, in sum, words, the transformation of passives into environmental actives.

The third factor refers to the goal of profitability combined with improved quality of life for people, through environmentally friendly practices.

It can be said that 3BL also promotes responsible and sustainable manufacturing; environmental responsibility; energy and resource conservation; renewable and less polluting energy consumption; recycling; minimization of packaging and carbon emission reduction; and the

development of social responsibility in products and services [19].

In this approach, these three factors must interact comprehensively with each other. When this is done successfully, the company can be categorized as sustainable. Sustainability is one of the pillars of the competencies required to train environmental engineers.

Due to the high consumption of electric energy and natural resources, as well as the need for cleaner sources of energy and the creation of more efficient technologies that can minimize environmental impacts, engineering professionals need to have not only the experience in a specific area but also broader expertise, so that they can relate their particular knowledge to other surrounding areas to understand and integrate production processes.

To this end, a methodological change in engineering education is crucial for professional development. The traditional methodology has proven inefficient when applied en masse. In this way, PBL can be a learning strategy for students to apply their knowledge to realistic and complex models.

Besides this, there is also the development of the ability to generalize and to learn different systems and tools that are relevant for engineering programs, because the professional of this area will need to propose solutions to problems that are often multidisciplinary [20].

In terms of 4RI with 3BL, the aim is to work on engineering within a sustainable approach to manufacturing while using the PBL methodology to improve production efficiency, merging profitability with environmental and social responsibility. Sustainable manufacturing seeks to implement processes and products that benefit society, do not damage the environment, and are economically viable.

By stating that sustainability, proposed as a management practice, this line of thought raises the efficiency of resource use and has better logistical interaction and efficiency, both socially and environmentally, when compared to more traditional approaches [21, 22].

### III. THE USE OF PROBLEM BASED LEARNING IN ACTIVE TEACHING METHODOLOGIES

The basic principle of Problem Based Learning (PBL) is a focus on problem-solving. PBL was established as a method of working with real, everyday problems for teaching purposes. This methodology is based on the hypothesis that by bringing cases from the students' extracurricular reality; they will be able to learn more easily. PBL was originally formulated to address the

problem that many students were unable to apply content learned in the classroom to real-life problems [23].

Real-life problems motivate the students to study the required content knowledge to solve them [21]. The methodology emerged in the medical school in the 1970s, at Michigan State University, with the intention of articulating theory and practice based on real cases.

In this way, a case was problematized and taken to the classroom, contextualizing the theoretical content with cases from reality, which the students would encounter in their professional lives. Such problems instigate consequent studies in monographs and scientific initiation research by the students [20, 24, 25].

Another relevant aspect of PBL is the positive impact on increasing self-confidence in students [26]. There was also another benefit from this approach, as "it contributes to metacognition, since it makes them reflect on their own way of learning".

By using PBL, from the exploration of a problem, to solve it, the student recognizes his best way to learn, as he will try to find the solution to the proposed problem by himself.

In this case, the teacher will function as the facilitator of learning, guiding him in the discovery process. Thus, the student will perceive his learning mechanism, in a form of metacognition [2].

From this curricular change, PBL gained space among other domains of knowledge and in other courses, contextualizing education with real-life problems. Therefore, PBL motivates the students to achieve independent learning [27]. This strategy to problem-based learning has been increasingly expanding in higher education fields other than medicine [27].

PBL contains many different approaches, but usually, it focuses on the instructional nature of case studies and project development [28]. In this way, the students learn by observing and solving problems from real situations and they become more active in the learning process because they are responsible for their learning. In this sense, the teacher becomes only a facilitator, while the students formulate and analyze the problem by identifying the relevant factors of the educational scenario.

PBL is characterized as an effective teaching methodology for developing skills in collaboration, communication, interdisciplinarity, innovation, and social responsibility [29].

In this sense, it is a methodology that has the purpose of innovating while fostering the development of the cognitive maturity of the students.

There is in PBL a strategic opportunity to provide more active teaching, in what they call a "real world of learning opportunities," so that learners can work with real sustainability cases [30].

Thus, the application of active methodologies in higher education has become an opportunity to renew the curricula of the universities, bringing students closer to the reality of the market.

This methodology, therefore, becomes a positive teaching strategy for the cognitive stimulation and motivation of students. Moreover, it is one of the requirements of the new DCNs. In the case of engineering courses, these methodologies help in the training of students for the new directions of the 4RI and 3BL.

#### IV. METHODOLOGY

The methodological basis of this study is based on mixed research, using the survey method with the questionnaire technique. To investigate the profile of the former student, we used the guidelines on competencies and skills, provided in the new national curricular guidelines for all undergraduate engineering courses, according to CNE/CES n.2 April 24, 2019 [7].

Once the competencies and abilities foreseen in [7] had been surveyed, a questionnaire with open and closed questions was prepared and made available on Google Forms for all students graduating from the environmental engineering course at a public Brazilian university selected for this study.

The sample space was 120 former students, considering the range of years from 2015 to 2020. The study of the former students covered from the first graduating class of the environmental engineering course of the selected university until the end of 2020.

From the universe of 120 graduates, we obtained  $n=36$ . Thus, we worked with a percentage of 30% of respondents/informants. In effect, the margin of error was 11.55%, according to the sample calculation by Solvis Company - research solutions; a 90% confidence level with heterogeneous distribution. The margin of error is the variation index of the results of a survey.

As the research was also dimensioned with a qualitative nature, the open questions of the questionnaire were analyzed and categorized for a better understanding of the results.

The categories were delimited considering: the respondents' opinion about the market demands; technical training; computer skills; languages and communication; personal relationships; technical writing; management;

qualification and knowledge of the technical area. In a second moment, a search was conducted in the best-known job vacancy websites in the country, such as Vagas.com, Catho, LinkedIn, Vagas Online, Jooble, Temos Vagas Online, and Seleção Engenharia, to verify the demands of the job market in the environmental engineering field.

The search keywords were environmental engineer, environmental engineering, environmental, environment so that it was possible to include job announcements that covered the whole area of environmental engineering or required this type of professional training.

We selected thirty-five job advertisements from dissimilar sources and companies to analyze the professional profile required by them, as well as the skills and competencies involved.

The selection was random considering the entire national territory. The exclusion criteria adopted were internships; trainee; and ads without profile, since the focus of the research was to investigate the profile required of the professional who had already graduated.

Ads without a profile, i.e., those that only inform the requirements regarding education and professional experience, without specifying details about the desired profile, such as the expected characteristics, skills, and competencies, were considered. From there, we observed what was common to all statements in the ads and computed the data, according to Table 8. We also observed in the statements the description of the job vacancy, and the respective prerequisites listed in them.

We also categorized the requirements found in the ads, considering technical requirements linked to the knowledge or the knowledge needed to perform the job; the desirable skills or what the company determines as a competitive differential trait for the candidate, in addition to characteristics and qualities determined by the companies, such as those linked to human and personal behavior.

Thus, a cross-referencing of the data from the survey with the former students, based on the questionnaire applied, with the data obtained through the selected advertisements, was performed.

It was assumed that the perception of the graduating students would reflect the reality of what companies demand from them when they get to the job market. In the same way, job vacancy announcements often contain a description of the profile requested. In this respect, it is worth remembering that the graduate profile refers to the estimate of how the student has reached the job market after finishing the undergraduate course, considering the parameters established by the competent Brazilian bodies.

The professional profile demanded by companies, on the other hand, reveals what must be adapted in the curriculum while meeting the university learning requirements.

## V. RESULTS AND DISCUSSION

Based on the principle that the professional profile required by the companies serve as an orientation for possible curricular changes, and that the graduate profile reveals the need for changes and adjustments aimed at meeting the market demand, it was possible to observe that the professional profile focuses on a summary of qualifications; skills; competencies; and the need of previous experiences.

In this way, we tried to observe in the wording of the ads the skills that are consistent with the environmental engineer's profession.

Besides the informants' personal data, we tried to identify the following: the year of graduation; whether they are currently attending an undergraduate or graduate course; whether they are attending graduate courses, their graduate scenario to verify demands; whether they are currently working, and what positions they are holding.

As for the graduate scenario, presented in Figure 1, it can be observed that: 41.6% are pursuing graduate studies; 8.33% are pursuing another undergraduate degree; 50% are not pursuing another degree; 16.7% are pursuing graduate studies in the area; 13.9% have already pursued some graduate studies in the area; 38.9% are not pursuing any graduate studies, but intend to do so; and 30.6% do not intend to pursue graduate studies. This indicates that most of the informants are interested in pursuing studies in environmental engineering.

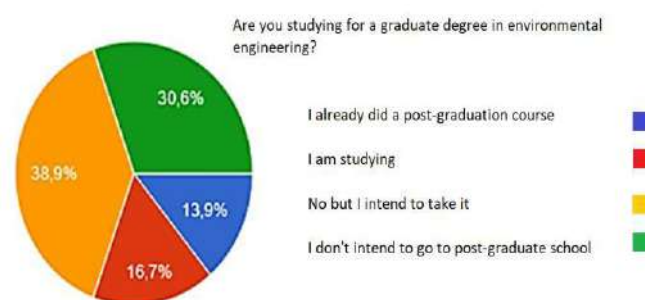


Fig. 1: - Post-graduation scenario

Source: author's data

Table.1: Post-graduation scenario

<i>Post-lato sensu</i> in the environmental area	Post-lato sensu in other areas
Post-graduation in Water, Environmental and Energy Resources Specialization in Geoprocessing	Postgraduate in Finance, Investments and Banking
Specialization in Urban and Environmental Engineering	Postgraduate Diploma in Occupational Safety Engineering
Environmental Management	Master in Remote Sensing
Environmental Management, Licensing and Auditing	Master in Energy and Environmental Engineering
Specialization in Water and Environmental Resources	Master's in water resources management and Regulation
	Master's in environmental management and Geographic Information Systems
	Master's in water resources management and Regulation

Source: author's data

The search for a graduate degree in the area reveals the graduates' behavior as to their interest in continued education and their expectation of staying in the area, which reveals a future estimate. Adding those who have already taken courses with those who intend to, and those who are taking courses, we got a satisfactory result, as far as interest in continuing the study is concerned.

Table 1 below shows the areas of greatest interest to graduates of the environmental engineering course. For both the *lato sensu* and *stricto sensu* courses, one notices a preference for the thematic areas of the environmental engineering course or areas related to the profession.

In this case, the scenario indicates which are the most sought-after areas, which may lead one to believe that they are more promising areas in the students' view or areas that are more desired by them. Moreover, this indication can also guide the course in the choice of certain areas.

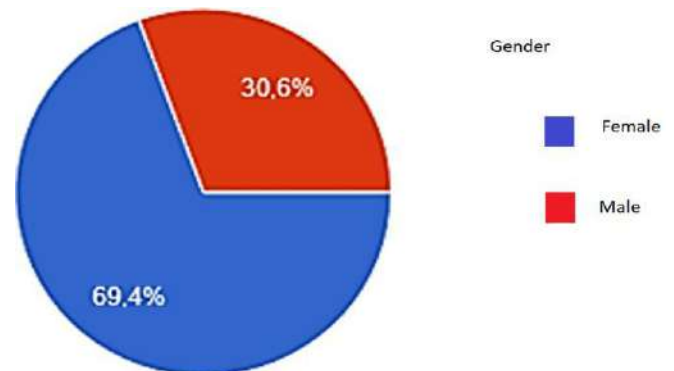


Fig. 2. Gender variable of informants

Source: author's data

Table.2: Are you currently working in the area?

Sim	In the area	Freelance/consulting	In another area	No
23	5	2	11	

Source: author's data

As for the gender variable, illustrated by Figure 2, the public is more female, both in terms of the number of respondents and the total number of graduates, which indicates greater participation of the female public in the

course studied.

Table 2 illustrates that: 63.88% work in the area; 5.55% work in another area; 30.55% do not currently work, which indicates that most graduates already work in the area.

Table.3: Positions held by informants

Positions in the area	Positions in the area
Full socio-environmental specialist	Global buyer of specialty ingredients
Hydraulic Engineer	Data Analyst
Environmental Analyst	
Town Hall Technical Officer	
Environmental Technician	
Environmental Supervisor	
Jr and Plenary Environmental Analyst	
Quality Manager at ISO/IEC 17025	
Project analyst	
Environmental Technician	
Technical Consultant	
Geoprocessing Analyst	
Environmental Supervisor	
Environmental Analyst	

Source: author's data

Table 3 shows that the positions held vary from engineer and analyst to technician. The result shows that most of the informants work in environmental engineering, which may indicate that these graduates are managing to work in the career, most of them already holding the position of engineer or analyst.

It is worth remembering that the names of the positions vary according to the organization of the company and the specificity of the function, although all require a full undergraduate degree.

It was also asked, as shown in Figure 3, the level of satisfaction about the education and professional performance in environmental engineering. The name of the university was omitted for reasons of ethics and confidentiality. The graduates indicated that, in general, they are satisfied with the education offered by the university. It is believed that most of the informants have a positive perception about the environmental engineering

course at the university where they graduated. Satisfaction is related to the state of Flow. The subject in this state is spontaneously and productively engaged in an activity [31]. When the subject reaches the Flow state, he is fully satisfied with the activity performed. He has more creativity, autonomous thinking, and well-being.

Do you consider that the environmental engineering course was satisfactory for your education and professional performance?

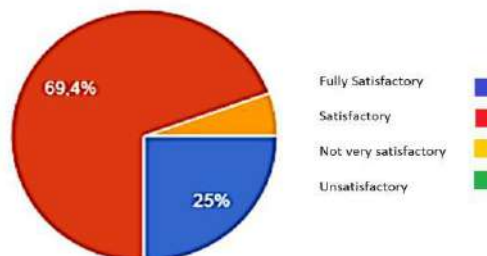


Fig. 3. Satisfaction about the training

Source: author's data

As for the market requirements, as exemplified in Figure 4, some categorizations were organized as follows: technical education, i.e., requirements as to an undergraduate and graduate degree; information technology: AutoCad, ArGis, Excel, and advanced Office package were the most listed. The same software also appears as a requirement to complete the profile of the environmental engineer in the companies' advertisements.

It should be noted that the professional profile is the sum of technical and behavioral requirements. Under these aspects, several skills and competencies were found to be frequent in the advertisements. Most of them expose these skills and competencies in the description of the requirements for the position.

In principle, a certain regularity was observed in these ads pointing to the basic requirements: good behavior; flexibility; leadership; credibility; dedication; creativity; responsibility; motivation; ability to work in a team; concern for customer satisfaction; proactivity, and resilience. In addition, technical knowledge is also truly relevant and is added to these characteristics. It was also observed that graduates are required to have advanced computer skills. In the following job vacancy announcement (Figure 4), computer skills appear as a requirement and no longer as a differential. One notices that topographic software is also in high demand, given the need for precision in technical work involving calculations and graphical representation.

**Environmental Analyst**

Description / necessary requirements: - Education: Environmental Engineering - Proven experience in the function, mainly in environmental licensing - Knowledge in waste management, effluent treatment and topographic software (Google Earth and QGis) - Computer: Office Package (Advanced Excel, Word, PowerPoint and Outlook) - Be communicative, have an influencer profile for environmental education, good relationship with team and managers main activities: - Control and update environmental licenses with the regulatory environmental agencies - Ensure compliance with legal records, as well as compliance with the technical requirements contained in the licenses - Align environmental guidelines and policies through the implementation of standards corrective actions and improvements - Monitoring environmental performance, management results and indicators of the area - Ensure the implementation of monitoring plans (water, wastewater, waste, atmospheric emissions, fauna and flora) - Prepare projects and / or monitoring reports of ecological restoration - Develop environmental education

programs with the community.

*Fig. 4. Announcement Environmental Analyst*

*Source: author's data*

Thus, the job vacancy announcements were analyzed together with the data presented in the survey to find out what were the common competencies and skills (See Table 4).

Table 4 shows that the university is not able to address this content within the pedagogical curriculum, following all the requirements described in the announcements. Thus, this knowledge can be contemplated throughout the course in complementary or extension activities. In languages and communication: advanced English and Spanish; experience abroad; oral and written communication skills were the requirements most mentioned by the informants. In personal relations, it can be said that personal marketing, soft skills, creativity, dynamism and proactivity, and teamwork complete the profile.

*Table.4: Job market demands*

Categorization	Market requirements
Technical Training	Undergraduate and Graduate
Informatic	AutoCad
	Argis
	Intermediate and advanced Excel
	Advanced Informatics

*Source: author's data*

*Table.5: Market demands regarding languages and communication*

Market requirements	Categorization
Languages and Communication	
Languages	Advanced English and Spanish
	Experience abroad
Communication	Written communication
	Oratory / oral expression



Oral communication / interpersonal relationships

Source: author's data

According to Table 5, regarding language knowledge requirements, it was observed that English is the most required language, followed by Spanish. Graduates are required to have these languages at an advanced or fluent level.

Oral communication was highlighted in the advertisements and the graduates' answers, both for interpersonal and commercial relations, and for training focused on environmental education. Therefore, this competence should be addressed in the environmental engineering course not only to meet the demands of the new curricular guidelines, but also to meet labor demands.

Table.6: Job market demands - technical writing and qualification

Categorization	Market requirements
Technical Writing	Reports
	Opinions
	Elaboration of projects
	Map-making and interpretation
Management	Environmental Management
	Project Management
	Management in general
Hability	CNH

Source: author's data

In management, the opinion of the graduates emphasized knowledge and the development of skills in Environmental Management, Project Management and General Management. However, some advertisements also requested other forms of management for the specific area of environmental engineering, such as waste management. Concerning the qualification to drive vehicles, the CNH becomes an important differential. In the following advertisement, Figure 5, one can observe the importance of written and oral communication for the position of full sustainability analyst.

In technical writing, the informants highlighted the importance of having a proficiency in reports, opinions, project preparation, and map interpretation, as indicated in Table 6. In general, universities prioritize projects and reports, which are often used in practical activities in the disciplines. However, a more in-depth approach to reading, interpreting, and producing reports and opinions are necessary to complete the education of the students. Some announcements even reinforce the use of communication, both for their production processes and presentations.

**Full Sustainability Analyst**

1 position: São Paulo

If you want to work on our Vivo Sustainable program, one of the strategic pillars of our Digitalize to Bring Together purpose, this position could be your opportunity. We are looking for a curious, dynamic professional who enjoys challenges, and is committed to social and environmental issues, to join the Responsible Business team at the VP of Institutional Relations and Sustainability. The main objective of this employee will be to promote the circular and sustainable economy inside and outside the organization, developing and maintaining projects, working on process control, and engagement plans with strategic partners. Completed university education in Environmental Engineering, Environmental Management or related field needed. Experience with waste management: Experience in medium or large companies, consulting with various focal points; Knowledge of environmental legislation and proficiency in laws, resolutions, and technical standards on waste. Intermediate/advanced knowledge with Excel and PowerPoint; Communicative and analytical skills that enable the elaboration of technical reports up to managerial presentations. Experience with modeling and database, performing analysis and interpretation, deriving conclusions, recommending actions, and reporting results visually.

Fig. 5. Announcement Full Sustainability Analyst

Source: author's data

The technical knowledge highlighted were environmental legislation; environmental licensing; ISO14001; effluent treatment; geoprocessing; environmental analysis; data analysis; data science;

geotechnology; limnology; map-making and interpretation; experience with social relations; and environmental technical knowledge.

Table.7: The most relevant course knowledge

Knowledge	Knowledge
Remote Sensing	Elaboration of projects
Geoprocessing	Sizing of water and wastewater treatment plants
Resistance of materials	Statistics
Meteorology	Hydraulics
Geology	Renewable Energies
Management	Environmental Law
Environmental Management	Limnology
Environmental modeling	Hydrology
Administration and economics	Field classes
Ecology	Topography
Geomatics	Solid Waste
Recovery of degraded areas	Environmental diagnosis and technical analysis
EIS, PRAD and geoprocessing report elaboration.	Environmental Management
Basic sanitation	Oratory
Logic and Programming	Jr. Company
Teamwork	

Source: author's data

The most relevant knowledge and skills from the course that was described by the graduates revealed what has been important for the exercise of the profession (as shown in Table 7). In the words of a former student of the environmental engineering course: "I use a lot of content from the university. These contents complement each other

for a complete understanding of the complexity of the interactions that occur in the various environments".

In these words, one notices the recognition that the knowledge worked throughout the course was useful for the professional life of the graduates. Although subjectivity is involved, it is noted by the answers of the informants that the knowledge pointed out as the most relevant in the course concerns impressions regarding the performance of the subjects, as well as the graduates' perception of the reality found in the labor market.

In this sense, it can be observed that not only specific knowledge of the course area is considered relevant, but there is also an emphasis on practical activities and transversal or interdisciplinary areas. It is believed that this is due to the skills and competencies recognized by the market at the time of hiring.

We can see that, in the graduates' view, there is a need to prioritize practice over theory, besides valuing the importance of extension practices, internships, and junior enterprises.

It is believed that this is a way of having contact with the reality of the job market and the basic contents of their course: "the greatest knowledge was gained through practical extension activities such as junior companies and internships" (former student of the environmental engineering course).

The importance of the knowledge of the legislation for the environmental engineering course is also highlighted. "Knowledge of norms, of laws, technical-environmental certifications, brought by environmental public agencies and a critical eye", is considered relevant, as shown in these words from a former student of environmental engineering course.

The results of our survey reveal that 80.6% of the informants believe that the course contents are satisfactory., while 13.9% consider it to be fully satisfactory, which indicates satisfaction regarding the basic content offered by the course. In this context, it is observed that there is neither dissatisfaction nor complete satisfaction with the course, but the students reported what could be further developed or improved in the course.

In Table 8, it is possible to see, from the analysis of the job ads, the requirements found for filling job vacancies by companies. For better organization, the ads were categorized into lists of technical knowledge, desirable or differentiated knowledge, and behavioral knowledge to better understand what the graduate needs to have to get the job.

Table 8 further shows the requirements for applying for environmental engineering job openings that align with the

new profile of the professional former student, integrated with the fundamental elements brought by 4RI and 3BL. Some of the fundamental elements of 4RI are internet of things (IoT); cyber-physical systems (CPS); machine-to-machine (M2M) communication; cloud computing and BigData. These elements are present in the various programs required of the job candidate.

Table.8: Categorization requirements found in job ads

Technical Requirements Know-how / Knowledge	Desirable Differential	Behavioral / Personal
Management of waste, projects, teams, quality, environmental	Language CNH topographic	Soft skills
Brazilian and International Regulatory Norms - NRs	Technical Information	
Circular economy and sustainability		
Environmental Legislation		
Environmental Impacts, Performance		
Environmental diagnostics and risks		
Occupational safety and environment		
Degraded areas and recovery		
Reports and technical reports		
Measurement and calibration equipment		
Management		
Geoprocessing		
Water Resources		
Solid Waste		
Atmospheric Emission		

Source: author's data

One of the principles of 4RI is to integrate the entire system horizontally and vertically to maintain data communication. Vertical integration acts on hierarchical levels, connecting all the company's internal processes, while horizontal integration refers to communication and data integration inside and outside the company.

In addition to making, it possible to work, share, and log data securely, these programs enable the user to work inside a data cloud. These principles are also aligned with 3BL by the integration they enable with each other, such as process security, resource efficiency, and the development of more flexible and intelligent processes.

In terms of 3BL, in Table 8, we notice greater demands in economic and environmental issues for the candidate for a job position in environmental engineering, either through knowledge and training in administration, which affect the productive systems of the companies or through experience and knowledge of management, norms and environmental legislation.

However, this focus has little direction on social issues such as work safety requirements; project management; and knowledge of the circular economy. It can be concluded that the profile of the candidate for the vacancy in environmental engineering is related to industry 4.0 and 3BL. However, little importance is given in the job ads to issues related to a concern for the community where the company is located. There is, therefore, a greater emphasis on the environmental and economic area in the advertisements.

It can be observed that besides technical knowledge, companies are looking for a professional who is willing to learn, initiative-taking, dynamic, and capable of bringing solutions to engineering problems. Once they have this knowledge, the chances of being hired will be greater.

Comparing the information collected in the advertisements with the pedagogical plan of the course, it was possible to observe that the course selected for this study addresses most of the market requirements. However, the expectations regarding management, computer resources, and specific management tools can be better explored by universities. Moreover, the inclusion of knowledge about soft skills is a challenge for the modern curriculum.

Although this knowledge is not treated in the curricular dimension, it can be worked on as complementary studies to the curriculum, or even, as an extension, according to the course organization and planning.

## VI. CONCLUSION

The research on the graduate profile allowed the comparison of these profiles and professional competencies required by the labor market. It is concluded that the notions of sustainability brought by 4RI, environmental management, project management, waste management, and management in general, are crucial knowledge for training in environmental engineering and

should be contained in the curriculum and in the pedagogical plans of the course.

The survey of the graduate profile can assist in decision-making by educational institutions to update undergraduate engineering courses, according to the guidelines of the competent educational bodies. Bringing together the demands of the market with the pedagogical content provides a more complete and up-to-date education. In this way, the student will have more opportunities in his or her area of activity. Although this study is for the identification of the graduate profile coming from the environmental engineering course, it also corresponds to a wide-ranging work, as it is also capable of involving the curricular updating of other engineering courses, in the most general aspects.

It is believed that this study can make use of the results to reformulate the pedagogical plans for engineering courses since many of the demands analyzed here are not only aimed at the specific area of environmental engineering. Furthermore, this is a study that involves current demands with a significant set of results.

In the decision-making process for filling job openings for environmental engineering, it was observed that, in addition to technical knowledge, there is also a demand for a professional with the following characteristics: willingness to learn; proactivity; dynamism; ability to point out solutions to engineering problems; ease of technical and personal communication in English, Spanish, and Portuguese. The students highlighted the importance of the link between the university and the industry to learn how to deal with the real problems of the industry. In this sense, the research points out that there is a need to implement PBL in engineering courses to meet the new curricular guidelines and ensure more effective teaching and learning.

According to the results of the satisfaction survey of the graduates, regarding their area of work, a search for continued education in a post-graduation course in the same field was noted, just as the importance of having a record of professional satisfaction among environmental engineers at the institution selected for this study.

The graduates are also satisfied with their education and current professional performance, having a positive perception of the environmental engineering course. However, they emphasize that the course is still very academic and that there is a greater need to make it more business oriented.

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# Analysis of the Current Management of Health Service Waste: A Case Study of a University Hospital in Manaus/AM

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**Keywords—Environment, Health Service Waste, Hospital.**

**Abstract**—The health waste management activity, whose steps range from the identification of generation sites to the environmentally appropriate final disposal, requires appropriate planning, where each step of the process needs to be performed properly to ensure worker safety and mitigate the impacts generated to the environment allied to the hospital costs. Current legislation, such as: Law 6.938/81, which deals with the National Environmental Policy, Resolution 222/2018, Law 12.305/2010, which establishes the National Policy on Solid Waste (PNRS), among others, guide this process. The general purpose of this case study is to analyze the current process of management and treatment of waste from the health service of the Hospital Universitário Getúlio Vargas (HUGV). To achieve these results, a quantitative/qualitative, exploratory descriptive research was carried out on the HUGV Waste Management Plan. The information was collected through an Observational Roadmap of the Current Flow, based on the ANVISA Board Resolution 222/2018. Consistently, the results obtained showed that the hospital cost of waste treatment is directly related to the management of HSW. With this, it was concluded that the management process carried out in the hospital is not fully in accordance with the current legislation, and that this non-compliance results in the high cost for the treatment and final destination of the HSW, demonstrating the importance and the need to update the hospital's PGRSS (Health Services Waste Management Program). The research makes a relevant contribution to the HUGV with suggestions for proposals for improvements in the work of managing HSW.

## I. INTRODUCTION

In Brazil, the CONAMA<sup>[1]</sup> Resolution 05/1993 defined minimum procedures for the management of solid health

waste, which was improved, updated and supplemented in the procedures with the definition and guidelines so that health services could update their Health Services Waste Management Program - PGRSS. The increase in waste

generation has become a global concern in the socio-environmental scenario<sup>[2]</sup>.

In this context, Anvisa<sup>[3]</sup> published Resolution 306 of 2004 regulating the Good Practices of Waste Management - PGRSS, guiding entities (both state, municipal and federal district) responsible for its inspection, with the help of local environmental agencies. In 2018, there was a review of the Resolution that gave rise to 222/2018 of the National Health Surveillance Agency<sup>[4]</sup>.

The PGRSS is defined as a framework of management procedures that establish the correct management of waste generated in the establishment<sup>[5]</sup>. The hospital units (HU) elaborate and implement the management stages, based on current legislation, adapted to their physical, personal and financial infrastructure.

Waste is dangerous because it contains probable biological agents such as bacteria, fungi, viruses, chlamydiae, rickettsiae, mycoplasmas, parasites and other agents, cell lines, prions and toxins that spread contagious diseases in the environment.

This paper is justified by the need for urgent measures to adapt the PGRSS to the new Resolution 222/2018, in order to avoid secondary impacts on human health, the environment and hospital costs. Aveni<sup>[6]</sup> points out the fragility and delay in issuing efficient responses during the Covid-19 crisis.

The research was developed with the general purpose of analyzing the current process of handling and destination of waste from the health service of the Hospital Universitário Getúlio Vargas - HUGV, using as specific purposes: Identify the current places of generation and segregation of the generated HSW; analyze the flow of the segregation, packaging and treatment process currently carried out in the HSW; to relate the current management of HSW with hospital cost for treatment and final disposal.

**II. BIBLIOGRAPHIC REVIEW**

**2.1 Classification of health service waste**

Studies have shown that most Brazilian municipalities do not have a PGRSS and do not follow the regulations for their proper management<sup>[7]</sup>. These negligences also point out the problems of inadequate management and its consequences for the environment, the professional and patient safety, in this case due to absence or poor management<sup>[8]</sup>.

Among solid waste, the HSW pose serious risks to health and the environment if handled improperly, because, in addition to having the presence of pathogenic organisms, they can compromise the quality of soil and

water<sup>[9]</sup>.

In addition to the Health Services Waste Management Plan, the resolution also presents the classification of waste into five groups, namely: group A (infectious); group B (chemicals); group C (radioactive) group D (common) and group E (sharps), according to the types of waste, their characteristics and examples presented in table 1:

Table 1: Classification of HSW pursuant to ANVISA Board Resolution No. 222/2018.

Group	Features	Example
A	Presence of biological agents that, due to their characteristics of greater virulence or concentration, may pose a risk of infection.	Culture mediums; disposal of vaccines; anatomical parts; viscera, leftover laboratory samples and their containers containing feces, urine
B	It comprises waste with chemical substances that can pose a risk to the environment and public health.	Expired, contaminated, interdicted, partially used medicines. Mercury and other heavy metal residues. Developer fluids and
C	Radioactive waste, i.e. any materials resulting from human activities that contain radionuclides.	Waste from groups A, B, C and D contaminated with radionuclides from clinical analysis laboratories, nuclear medicine and
D	Waste with no biological, chemical or radiological risk to health or the environment.	They are similar to household waste. Toilet paper and diaper, sanitary napkins. Leftover food from patients or leftovers from food
E	It involves sharp materials.	Objects and instruments containing sharp, sharp edges, corners or protuberances capable

Source: ANVISA Board Resolution 222 (2018).

**III. METHODOLOGY**

The research characterizes as qualitative/quantitative, according to Silva<sup>[10]</sup>, qualitative research in health, as far as it can be seen, that several authors Bosi<sup>[11]</sup>, Campos<sup>[12]</sup>,

Silva, Mendes & Nakamura<sup>[13]</sup>, Minayo & Guerriero<sup>[14]</sup>, Ramos et al.<sup>[15]</sup>, Ribeiro et al.<sup>[16]</sup>, has been validating the legitimacy of nature and method, in a way that is consistent with the epistemological field.

As for the purposes, the research is descriptive and exploratory, the descriptions are prepared when there is already a robust framework of knowledge that accepts to accurately identify the variables that clarify the fact<sup>[17]</sup>.

The sites of generation and segregation of waste in each clinic were researched, the information was collected through two Observational Roadmaps (RO) of the Current Flow based on ANVISA Board Resolution 222/2018 (Figure 2).



Fig.1: Flow of data collection.

Source: Authors, (2021).

The research took place on-site, during the day, following the normal routine of the wards. The spaces of the utility rooms, displacement of the collection cars, the internal logistics for the external shelter and the organization of the external shelter were verified. It was observed that the waste is stored in the rooms for each group and, subsequently, weighed (this is the case of waste from group A, B and E), which occurs when the contracted company carries out the external collection. The estimated average weight generated daily was collected from the spreadsheet of the person responsible for environmental management.

Financial data were collected on the Federal Government website COMPRASNET (public data). The study was carried out at the Hospital Universitário Getúlio Vargas - HUGV, Manaus-AM. HUGV plays a strategic role in the training of human resources and development and technology for health, providing its physical and technological infrastructure for practical training of students at the Universidade Federal do Amazonas - UFAM.

**IV. RESULTS AND DISCUSSION**

**4.1 Waste of Group A**

According to ANVISA Board Resolution No. 222 of 2018 and CONAMA, it is mandatory to segregate waste at the time of generation at source, waste must be subjected

to microbial inactivation when necessary, at the unit itself. At HUGV, an outsourced company was hired to carry out the treatment and final disposal of this group, as it does not have the structure to carry out internal treatment.

Regarding Group A, the following observation was made: “Is the waste properly segregated at the time of generation?” (Figure 3). In all clinics, the generation of waste from the group was found, taking into account the observed locations, only in 20% of the clinics studied were observed properly segregation.

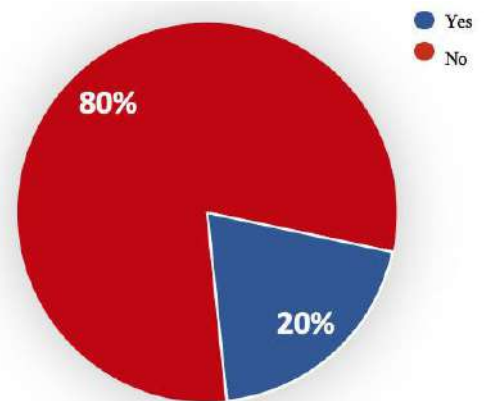


Fig.2: Is the waste properly segregated at the time of generation?

Source: Authors, (2021).

Segregation consists of separating or selecting waste according to its classification, actions must be carried out at the time of generation, at the origin. It was possible to verify that in some containers, common material is discarded, such as enteral nutrition bags (Figure 4), syringe packages (Figure 5), which is a matter of concern, since they will be weighed and sent to an outsourced company for treatment and final disposition.

Biological agents are microorganisms capable or not of causing some type of infection, allergy or toxicity in the human body, such as: bacteria, fungi, viruses, chlamydiae, rickettsiae, mycoplasmas, parasites and other agents, cell lines, prions and toxins. (2018). Empty Enteral Nutrition packages are considered common waste (figure 5), they are framed in Art. 40 of ANVISA Board Resolution 222/2018, as they do not represent a biological, chemical or radiological risk.

In the containers observed with infectious waste, 80% of the clinics do not properly segregate this waste, presenting mostly syringes and plastic packaging.





Fig.3: Common waste (enteral nutrition bag)

Source: Authors, (2021).



Fig.4: Common waste (packaging)

Source: Authors, (2021).

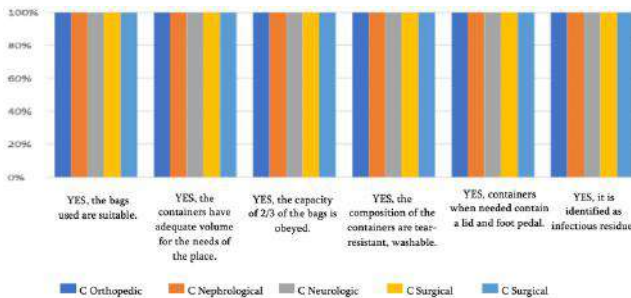


Fig.5: Quality of the containers used to segregate waste of Group A.

Source: Authors, (2021).

When observing the quality of the bags and containers, it was found that the bags used in the packaging are of good quality, thus avoiding the use of double bags, all are standardized with the symbol of infectious material and obey the capacity of 2/3, allowing to close securely, ensuring integrity and correct handling by cleaning personnel. ANVISA Board Resolution 222/2018 recommends that they must be red, but white is used, supported by GVIMS Technical Note No. 04/ANVISA.

Taking into account the size of the hospital and the distance between the generation sites and the external shelter, HUGV uses the utility room (space inside the clinics) for temporary storage. Observing the internal collection II (it is recommended in the hospital that the internal collection I is the collection of collectors from the point of generation and their storage in the temporary waste storage) the collection cars are removed from the corridors 3 (three) times a day **Waste of Group B.**

Waste of Group B is generated in all clinics participating in the study. When checking the group's waste containers, it was noted that there was a mixture with common waste, especially in the containers with medicine bottles. It was observed whether the waste was properly segregated at the time of generation (Figure 6).

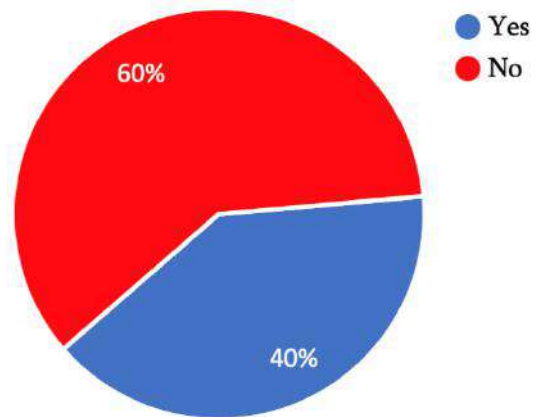


Fig.6: Is the waste properly segregated at the time of generation?

Source: Authors, (2021).

In 60% of the clinics, the segregation of medication vials is performed incorrectly, as the disposal of syringe packages is observed in the same container used for the glasses (Figure 7). Proper management of RSS, especially in hospitals, in any situation, contributes to minimizing the risks to professionals involved in the management and to the environment<sup>[18]</sup>. These items can be toxic, pathogenic and environmentally adverse due to their non-biodegradable and/or reusable nature<sup>[19]</sup>.

It is important to note that generating establishments must verify whether or not the management of RSS is in compliance with these laws, especially regarding the correct segregation in the source of generation and final destination according to their classification Aduan et al.<sup>[20]</sup>.



Fig.7: Container with medicine bottles

Source: Authors, (2021).

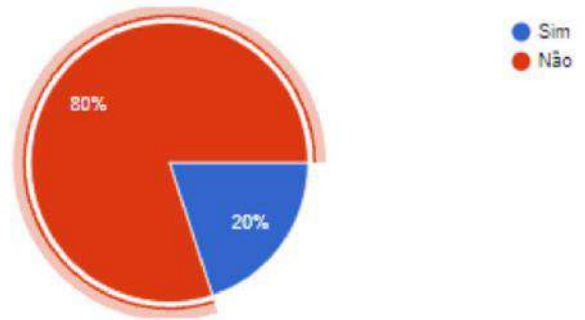


Fig.9: What percentage of segregation of primary drug packaging according to Paragraph 3 of Art. 61 of ANVISA Board Resolution 222/2018.

Source: Authors, (2021).

Medicine bottles are sent to the external shelter for temporary storage. When they reach the storage capacity of the place, the outsourced company is asked to collect it from the outside, which occurs every 15 days. The bags used for disposal of waste of group B are of adequate quality and size for the amount generated in the locations, not exceeding a capacity of 2/3.

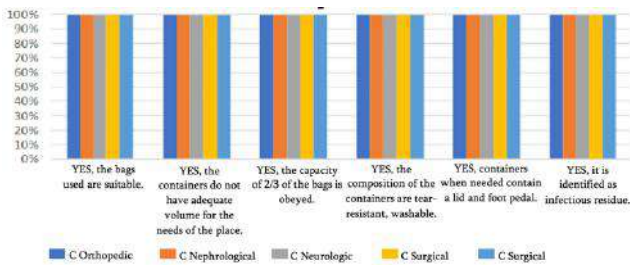


Fig.8: Regarding the quality of the bags and containers used to waste disposal of Group B. Source: Authors, (2021).

At the time of segregation, packages containing hormonal, antimicrobial, cytostatic, antineoplastic, immunosuppressive, digitalis, immunomodulatory, antiretroviral products were observed, all of which are sent to an external shelter for further treatment.

Of the five clinics studied, only 20% (Figure 9) have empty packaging segregation, whose components are not part of the classification according to Art. 61 of ANVISA Board Resolution 222/2018.



Fig.10: Segregation of empty solution bottle in the Nephrology Clinic

Source: Authors, (2021).



Fig.11: Empty solution bottle in the Clinic

Source: Authors, (2021).

It was identified that in the Nephrology clinic, the pilot project of "segregation process of empty solution packaging" was started, the initiative is supported by Art. 40 of ANVISA Board Resolution 222/2018, "HSW

(Health Service Waste) that do not present biological, chemical or radiological risk can be sent for recycling, recovery, reuse, composting, energy recovery or reverse logistics”, and in Paragraph 3 of Art. 61 “only empty containers of non-hazardous chemical products can be sent to recycling processes”.

Daily, after the use of the saline solution bottle, which was not contaminated, the nursing team breaks the equipment, removes the identification label and places only the saline bottle in the identified container (Figures 10 and 11); an average of 1.7k of empty solution bottles are segregated and weighed daily in the clinic. However, the Hospital does not send it for recycling, as the recycling symbol does not appear on the packaging of its products.

Another pilot project observed at the Nephrology Clinic is the reuse of Buffer Solution packages (acetic acid- $H_3CCOOH$  and acetate ion- $H_3CCOO^-$ - Figure 12) for packaging empty medication bottles (Figure 13)



Fig.12: Bottles of buffer solution (acetic acid ( $H_3CCOOH$ ) and acetate ion ( $H_3CCOO^-$ )).

Source: Authors, (2021).



Fig13: Re-used Buffer Solution Pack.

Source: Authors, (2021).

The buffer solution is widely used in the Clinic, and the

packaging, when not reused, is donated to the collectors' cooperative (the company is selected through Electronic Auction). The initiative collaborates with the reduction of the negative visual aspect in the hospital environment.

The group's internal waste collection is carried out 3 (three) times a day. The packages are stored in the external shelter, are destined for external collection when they reach the storage capacity of the place.

- **Group C waste.**

No generation of residues from Group C was observed.

- **Group D waste.**

In all Clinics, Group D waste is generated, as shown in Figure 16. Waste from this group is classified as tailings, except when sent for reverse logistics, energy reuse, recovery, recycling, recovery or reuse.

Most of the waste in the clinics is leftover food, properly segregated in 100% of the clinics. However, it was observed that there is a large amount of residues in this group, especially after meals.



Fig.14: Container with residue from group D.

Source: Authors, (2021).

The containers used do not support the amount generated and withdrawals are not performed when necessary (Figure 14), it was observed that the bags are incorrectly placed in the containers.

In all clinics there were collectors for common waste, however the containers are of inadequate size for the amount of waste generated in the environments; the 2/3 capacity is not observed, leaving the packages overflowing, as can be seen in Figure 14.

We find good quality bags in all clinics, the composition of the containers allows washing, they are tear-resistant, they contain a lid and pedal, they are all identified as common waste.

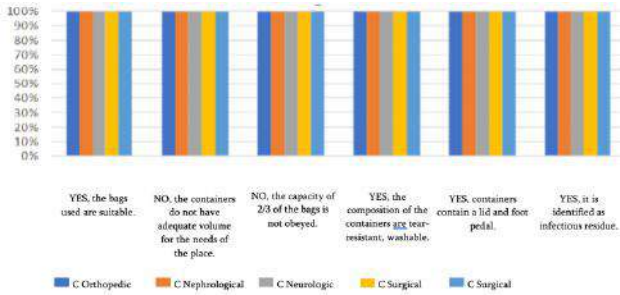


Fig.15: Regarding the quality of the bags and containers used to dispose of waste of Group D.

Source: Authors, (2021).



Fig.18: Group E waste.

Source: Authors, (2021).

Collection of residue from group D is performed three times a day (Figure 19) in all clinics.

• **Group E waste.**

In all Clinics, Group E waste is generated. Boxes are placed in all wards and medication rooms.

When observing whether there is adequate segregation, it can be seen that in 60% of the clinics there was a mixture of materials in the boxes (Figure 16)

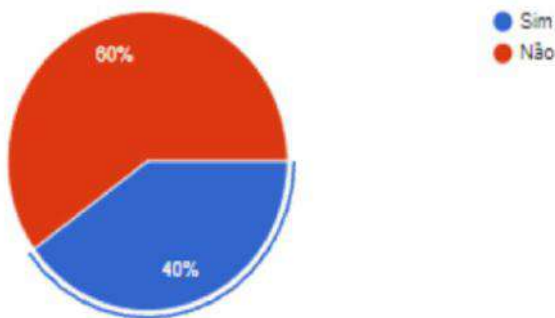


Fig.16: Group E waste is properly segregated at the source of generation.

Source: Authors, (2021).

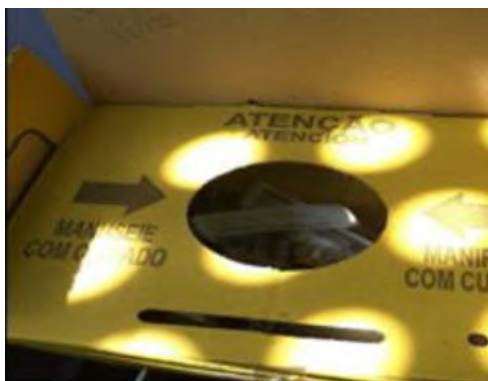


Fig.17: Sharps box.

Source: Authors, (2021).

The materials most seen in the boxes are syringes, gauzes, tubes of ointments and packaging (Figure 18). At the time of segregation - when carried out improperly - common waste, in possible contact with the contaminated ones, are considered infectious, which contributes to an increase in the amount of contaminated waste, increasing the risks for the personnel who handle them and for the population<sup>[18]</sup>. This situation is concerning, as this waste will be heavy, and the treatment has a significant cost for the hospital.

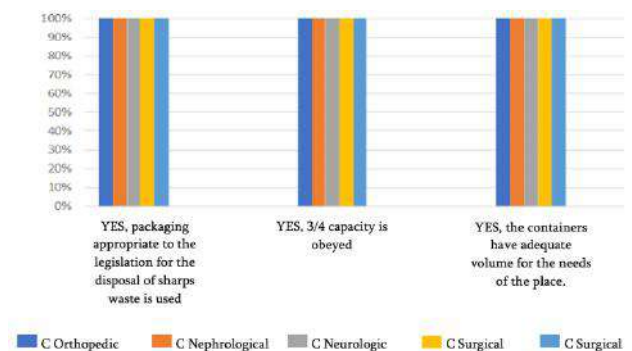


Fig.19: Regarding the quality of packaging (boxes) used for waste disposal

Source: Authors, (2021).

In all clinics, appropriate packaging is used for the legislation for the disposal of sharps, the capacity of 3/4 is obeyed, and the containers have adequate volume to the needs of the observed places, the boxes are identified with all the risks present in the content.

The internal collection of waste from group E are scheduled 3 (three) times a day, but the boxes with the sharps are only sent to the external shelter when they reach their maximum capacity of 3/4.

• **Space for temporary storage.**

In the Roadmap, it was verified whether "the spaces

intended for temporary storage (place for waste from group A, B and C, which can be in a specific place within the clinic itself) meets the demand of the place". In the HUGV, the area destined to this demand is the utility room, because the space does not hold the collection cars, leading the team to choose to store these cars in the corridor next to the elevators (Figure 20).



Fig.20: Temporary storage.

Source: Authors, (2021).

The legislation provides for the use of a multipurpose space, provided that, in addition to the minimum area of 6m<sup>2</sup>, it also has an additional 2m<sup>2</sup> (HSW 222/2018). Due to the need for space, the Environmental Management team adjusted as follows: in the Nephrology clinic, the collection cars are located in the DML room (a room for storing utensils and cleaning material). In the Medical, Neurology, Orthopedics and Surgical Clinics, carts are in the aisles.

When observing the quality of the carts used in the transport of collection II, it was found that they comply with current legislation, are made of rigid material, with wheels and allow adequate cleaning.

The collection carts used for the internal transport of waste from the temporary shelter to the external shelter are made of suitable material (with wheels, cover and identification), the carts are transported through a service elevator, at defined times, in order to avoid conflict of schedules with the other services that meet the demand of the hospital.

According to Gomes<sup>[21]</sup>, Health Institutions must prepare a PGRSS based on the characteristics and classification of waste, making it mandatory to prepare a plan to raise awareness of the correct management of HSW and environmental and occupational safety conditions (2018).

It is recommended at the Hospital that collection I is the process that begins at the time of segregation at origin, collection II refers to the logistics carried out between the

temporary storage and the external shelter, and collection III is the removal of waste from the external shelter by the specialized companies until its final destination.

The external shelter, located on the ground floor of the hospital, has its dimensioning adequate to the internal demand, the frequency of collection of the urban municipal cleaning system and the routine of the outsourced company that performs the waste treatment. There are separate environments exclusively for groups A and E, B, D, thus avoiding cross-contamination (Figure 21).



Fig.21: External shelter environments, intended for waste storage.

Source: Authors, (2021).

Table 2: External storage of Group A, B, D and E.

<p>Group A</p>	<p>It was verified in the guide that the space meets the daily demand. External collection is carried out once a day (Figure 26), to carry out the treatment of waste, the Hospital hired a specialized company, which is responsible for collection and external transport. The waste goes through an incineration process and then goes to the sanitary landfill. The company is located in the Terra Nova neighborhood in the city of Manaus/AM.</p> <p>As recommended in item I Article 6 of ANVISA Board Resolution 222/2018, there is an estimate of the amount of waste generated from Group A, which corresponds to the monthly average of 4,493.92k (four thousand, four hundred and ninety-three kilograms and ninety-two</p>
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Group B	The space destined to the temporary storage of group B meets the demand, the solid residues of the group (bottles of medicine glasses and other packages containing chemical products), are stored in the temporary shelter in boxes, and sent to the outsourced company for incineration every fifteen days (Figure 26). The final destination is the sanitary landfill. In compliance with item I Article 6 of ANVISA Board Resolution 222/2018, the estimate of the amount of waste generated from Group B corresponds to the monthly average of 237.11 k (two hundred and thirty-seven kilograms and eleven grams).
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Source: Authors, (2021).

• **Group D**

The largest amount of waste generated is from group D, external collection is carried out once a day, and is carried out by the city hall and destined for the sanitary landfill. The monthly average of common waste sent to the sanitary landfill is 3,731.18k (three thousand, seven hundred and thirty-one kilograms and eighteen grams) (Table 3), an underestimated number, since the night collection is not heavy, however it serves as a parameter for adjustment actions in internal processes.

However, it was observed that there is a significant amount of group D waste materials that are not rejects, which can be recycled, and receive the destination as follows:

- Reuse: alcohol and buffer solution packages;
- Recycling: The hospital has a donation contract with a collectors' cooperative where the paper, cardboard boxes, cans, gallons of buffer solution and other plastics that do not contain hazardous or flammable waste are destined;
- Reverse logistics: No implementation project was observed, there are many materials such as batteries and fluorescent lamps, which can be collected by the supplier companies. However, there is a gap in this process since clear rules have not yet been defined with the material suppliers. By the rules, these residues are classified as Class I residues (NBR 10.004/2004).

The result demonstrates that the hospital is behind schedule with the implementation of actions according to the guidance manual of the Ministry of the Environment (MMA) that addresses the elaboration of Solid Waste Management Plans.

Table 3: Estimate of group D waste generated from January to August 2021.

Health Service Waste Group	External Collection Frequency.	Is HSW weighing performed?	Monthly average estimate.
Group D	Once a day	Partially	3,731.18k
Monthly Average Waste			3,731.18k

Source: Environmental Management Commission/HUGV, (2021).

• **Group E**

The external storage meets the hospital's demand, the contracted company performs the collection once a day, where they are sent for incineration and final disposal in the sanitary landfill. The monthly average is 389.16k (three hundred and eighty-nine kilos and sixteen grams).

• **Hospital cost with health service waste management.**

As the Hospital does not have the structure to perform treatment in the unit, it was decided to outsource the service through a specialized company, defined through Electronic Auction, the contract has as its purpose the collection, treatment and adequate final disposal of HSW. The amount paid per kilo collected in the year is BRL7,0301 (Notice 64/2019-COMPRASNET).

Table 4: Estimate of group A, B, E waste generated from January to August 2021.

Health Service Waste Group	External Collection Frequency	Is HSW weighing performed?	Monthly average estimate
Group A	Once a day	Yes	4,493.92k
Group B	Twice a month	Yes	237.11k
Group E	Once a month	Yes	389.16k
<b>Monthly Average Waste</b>			<b>5,120.19k</b>

Taking into account the average generated per month of 5,120.19k (Group A, B, E), the hospital bears a monthly cost in the range of BRL35,995.47 (thirty-five thousand, nine hundred and ninety-five reais and forty-five reais and seven cents) with waste treatment.

It is evident that the volume of HSW is quite

expressive, and this amount is directly related to segregation at origin. Adequate segregation reduces the amount of contaminated waste generated, which results in a decrease in costs with treatment and disposal of this waste and the recycling of common waste<sup>[22]</sup>.

Segregation, often inadequate, raises waste management costs for generating entities, because when common waste is discarded together with the infectious waste, the volume of contaminated material increases, increasing hospital costs, as these are paid per kilo of waste to be treated<sup>[23]</sup>. In Brazil, however, still around 27.5% of municipalities allocated their HSW without declaring the previous treatment given to them<sup>[24]</sup>.

Improving the quality of services provided with a balance between economic, social and environmental costs is the biggest challenge for the hospital segment<sup>[25]</sup>. The results obtained show that the hospital cost with waste treatment is directly related to the management of HSW, that is, inadequate segregation, greater financial resources will be needed for treatment and final disposal.

**V. CONCLUSION**

With this research, it was possible to observe, through the literature analysis, the observational guides in the clinics and in the external shelter, pertinent legislation, and the guidelines of the policies of health and environment agencies, that the management process carried out in the hospital is not fully in accordance with the current legislation, and that this non-compliance results in the high cost for treatment and final destination of the HSW generated in the health care activity.

Materials such as: collection carts, bags, boxes with sharp holes and containers for segregation, necessary to comply with the process, comply with the legislation, and are even standardized in all clinics. This positive point allows the safety of the worker, avoiding work accidents.

In the area of the external shelter, the separate and identified spaces for the storage of waste according to legislation is another positive aspect of HUGV, avoiding cross-contamination and prioritizing the safety of collecting agents, allowing adequate organization at the time of transport to their respective destinations. The weighing performed serves as a parameter for the necessary adjustments and control of payments to the outsourced company.

The initiative to implement the project to segregate solution vials in the nephrological clinic is an important step in reducing costs, as it is a product used on a large scale within the hospital. In this thinking, it is a matter of implementing the protocol in other clinics, being the first

step towards a feasibility study to send the bottles for recycling.

However, regarding the non-conformities aspects, the spaces for temporary storage of the collection carts were observed, which is a problem to be solved, since the place where they are allocated, in addition to bringing visual pollution, can represent a danger to passers-by who access the corridors. Searching for alternative solutions for this situation is a priority to comply with the current legislation.

The routine practiced by professionals demonstrates disagreements with what is recommended in ANVISA Board Resolution 222/2018, generating risks to workers' health and the environment.

The inadequate segregation observed in the clinics in this study could be minimized by implementing *on-site* training for professionals, in addition to raising awareness of the importance of the PGRSS to improve segregation, making it possible to add a culture of worker safety and concern for the environment.

When it comes to the management of hospital waste, it is possible to notice the large gap in knowledge and/or non-compliance with the protocols of health professionals, mainly according to the specificities of groups A, B and E. Ordinary waste was unnecessarily sent for treatment, which leads to an increase in treatment and final disposal costs.

The relation between inadequate management and hospital costs is directly related since common waste was evidenced in several containers destined for waste from Group A, B and E. Payment for treatment and final disposal is estimated per kilo generated, which can be reduced if correctly segregated at source.

From this perspective, it is extremely necessary that new training and awareness-raising actions are created to meet the current regulations regarding segregation and, in this way, contribute to the reduction of financial costs related to the treatment.

As a contribution, this paper suggests updating the hospital's PGRSS with the following actions:

1	Training and awareness-raising actions are created to meet the current regulations regarding segregation. However, in order for it to become a continuous action, it is necessary to insert the role of action multipliers in each clinic, with biannual or annual rotation. The professional would be awarded institutional recognition through a "Hospital Friend" certificate (or another nomenclature that represents the dedication of the server) with wide
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2	Display in a visible place an explanatory folder on the classification of each waste generated so that it can be consulted at the time of segregation or affix the containers with the indication of the items that can be segregated.
3	Expand the solution bottle segregation project to all clinics where they are used, as it is a viable means of saving for the hospital. It can even create an internal classification to award the clinic with the highest quantitative acquisition of a segregated bottle. Verify the possibility of inserting in the notice for the acquisition of solution that the manufacturers meet the technical standard of ABNT (Brazilian Association of Technical Standards) NBR 13230, which defines the symbology for identifying plastic materials.
4	As for the space destined for the collection carts that are in the aisle, the team can carry out a study of the physical spaces that currently exist, in order to allocate them more safely or reduce the size of the collection carts so that they can be placed within the current area, but increasing the number of times they are collected.

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# The role of university extension in promoting local economic development: A preliminary discussion in light of the specificities of a small municipality

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**Keywords**—college education; local economic development (LED); small town; university extension.

**Abstract**—Here we discuss the role of university extension in local economic development (LED) processes. For this, we use the theoretically based formulation of an operational concept of university extension and its application to the context of a small municipality (Iporá, Goiás, Brazil). We analyzed different requirements and indicators related to extension activities and how they are perceived, appropriated, and used by local actors. Therefore, the research was based on an exploratory-qualitative methodological approach, encompassing two procedures: document analysis to build an operational concept of university extension and semi-directive interviews with local actors. As a result, a consistent adherence of the operational concept of university extension to the interactions/relationships analyzed in the context of LED in Iporá was identified, corroborating and requalifying the meanings of these extensionist practices in favor of a progressive socioeconomic dynamism perceived by LED actors.

## I. INTRODUCTION

In actions based on the teaching-research-extension tripod, the university emerges as a relevant actor in the gear of local development insofar as it plays multiple roles in the training of qualified human resources and as a catalyst for public and private investments in science, technology, and innovation (OLIVEIRA JR, 2014). Although integrated on a tripod, university initiatives in teaching, research, and extension can be subdivided according to different attributes, such as the type of impact generated in society and the nature of the link maintained between the educational institution and the external community. From this point of view, the extension stands out as the pillar that articulates and serves as a bridge so that resources and/or results of teaching and

research are taken to society in the form of projects that generally seek to engage and bring tangible benefits to this public not directly linked to the university (OLIVEIRA JR, 2014; WOLFF, 2013).

In this way, university extension actions can trigger more immediate impacts on the socioeconomic processes that occur outside the institution. Indeed, the university establishes itself as a member of the network of actors involved in the Local Economic Development (DEL) processes (PACHECO, 2010). However, the constraints and consequences of this university-society relationship, via extension projects in the face of LED policies and strategies, are little discussed, especially when referring to small localities characterized by a tenuous economic dynamism. To understand these phenomena, this

article uses two interconnected research stages: the formulation of an operational concept of university extension and its empirical application to the context of the city of Iporá, in the case of a small municipality located in the state of Goiás, Brazil.

The city of Iporá has grown to a population of approximately 30,000 inhabitants over the last decade, has been classified as an emerging municipality (IBGE, 2019) and, since 2010, hosts a campus of the Instituto Federal Goiano (IF Goiano), the only federal public education institution in highest of the entire micro-region (IBGE, 2019)

In general terms, these efforts aim to describe and analyze university extension as a dynamic instrument for local economic development in a small town. To this end, the methodological approach, anchored in a theoretical framework dedicated to the interrelationships between the performance of the university and the dynamics of LED, used two procedures: a) document analysis of the directive frameworks elaborated by the Forum of Pro-Rectors of Extension of Public Institutions of Higher Education in Brazil (FORPROEX), to meet the objective of building an operational concept of extension in an LED environment and, b) the analysis of empirical data obtained through 24 semi-structured interviews. In addition to this Introduction and Final Considerations, the article includes three other intermediate subsections that deepen the topics mentioned here: the Theoretical Framework, Methodology, and Results and Discussion. As a result, analytical contributions of the operational concept of extension are highlighted. It highlights the concrete and symbolic benefits of LED actors in the region, emphasizing the appreciation of extension activities based on transversality in meeting social and university-community integration demands.

## II. THEORETICAL REFERENCE

This section presents the main theoretical assumptions that support the analytical model of Local Economic Development (LED) and compares these aspects with the key points that characterize university extension in general. It is worth mentioning that the LED model advocates a level of analysis that translates into an emphasis on networks of actors capable of building the reality of local economic development, understanding as an actor all agents (individual or collective) that influence public policy processes (SECCHI, 2013). Therefore, governmental actors (politicians, bureaucrats, judges) and non-governmental actors (civil society organizations, class associations, media) are covered, as well as clear importance to higher education institutions (public

universities, Federal Institutes of Education and private colleges) that often act as facilitators and/or bridges between the various parties involved (ROMEIRO; PREARO; MAZZALLI, 2011; FELDMAN; DESROCHERS, 2003).

In this sense, it is assumed that the localities have diverse resources and unexplored economies of scale projected into a development potential whose objective is to promote greater socioeconomic dynamism and improve the community's quality of life (MORAES, 2016). According to Arbo and Benneworth (2007), competitive advantages tend to be created and sustained by highly localized processes, in such a way that the multiplication of links and connections in the form of networks of local actors, in parallel with the need to reduce transaction costs, make the proximity an important and strategic asset. As these networks consolidate, LED actors strengthen their connections and begin to share trust and reciprocity norms that are configured as a "public good" and, in this scenario, there are incentives for a better exchange of information and expansion of access to resources and a greater ability to seek collective solutions to local problems (FELDMAN; DESROCHERS, 2003).

In general, the role played by the university in these processes is multifaceted, and one of its pillars is the dissemination of knowledge. This idea is based on a type of positive externality triggered by typical activities developed at the university, and that reaches other social actors in terms of access and appropriation of knowledge and diverse knowledge. This chain of knowledge transmission is conditioned to a limited geographic scope and is materialized in two main aspects: formalized/codified knowledge and tacit knowledge. The first refers to formally systematized knowledge that can be stored, copied, and transmitted. The second concerns non-formalized knowledge normally accumulated through personal experience, practical learning, and social relationships (DÖRING; SCHNELLENBACH, 2004).

The articulation between formalized knowledge and tacit knowledge has particular weight in university extension since it tends to assume an interconnected posture between transmission and learning, through which knowledge can be constructed in the application/experimentation of different combinations of the two types of knowledge. The knowledge contributed to extension activities both by the technical-scientific body and external beneficiaries (ETZKOWITZ, 2001). It should be noted that university extension involves the execution of technical-scientific projects to be applied outside the educational institution for the benefit of the external community, thus bringing together researchers, students, and technicians from the university, on the one hand, and

public or private agents, and on the other hand, beneficiaries. In this context, it is expected that both parties will have opportunities to contribute solutions to the collective problem highlighted in the project and that all participants can improve and empower themselves throughout the process.

Therefore, the centrality of interpersonal relationships and community bonds is reinforced, which gains strength precisely in proximity spaces at the local level. Such ties can be seen as one of the main driving forces of local economic development (LARÉDO, 2003). Concerning university contributions, Arbo and Benneworth (2007) argue that three levels of interaction/relationship with LED actors can be identified: macro, meso, and micro. At the macro level, the emphasis is on the institutionalized articulation that unites the university – through its governing body and under the support of its legal mission – to key actors in the LED network (instances of public authorities and business and society leaders, for example). This link is usually more consultative and/or focused on the university's political action vis-à-vis other actors and not specifically related to specific public policies. The meso level is directly related to extension as it is embodied in research groups and extension projects that bring together teachers and students around specific thematic axes that, in turn, are associated with LED actors both in consultative and operational bases, with emphasis on delimited social groups and sectoral public policies. Finally, the micro-level of relationship revolves around the personal bonds established between highly qualified university employees and people in the community that contribute to the strengthening of civil society and creating positive impacts on LED processes (ARBO; BENNEWORTH, 2007; HARLOE; PERRY, 2004). The three levels of interactions listed above will substantiate the formulation of an operational concept of university extension activity whose characteristics allow us to understand the determinants and conditions that contribute to the empirically examined LED dynamics.

### III. METHODOLOGY

This topic details the methodological procedures of an exploratory nature used in the article. Thus, anchored in the theoretical framework, the research design initially used the analysis of documents related to the National Policy for University Extension (PNEU), the guidelines for evaluating university extension practices contained in the publication entitled “Assessment of University Extension: practices and discussions of the permanent extension evaluation committee” (FORPROEX,

2013) and Resolution No. 7 of the Ministry of Education, of December 18, 2018 (BRASIL, 2018).

Subsequently, qualitative research was carried out to encompass a comprehensive group of social actors from different segments that work in the region's development processes. Thus, 24 semi-structured interviews were conducted with two large groups: actors from the internal community of IF Goiano (11 interviewees) and actors from the external community (13 interviewees). Among the first 11 are managers of the Rectory of IF Goiano, local managers of Campus Iporá and those directly responsible for the areas of research and extension. Among the remaining 13 are class and union leaders (both employers and workers), leaders of the municipal Executive and Legislative branches and representatives of civil society (community leaders and media outlets).

The interviews were guided by a semi-directive script dealing with themes that sought to explore from the actors' understanding of the concept of university extension to the empirical context of the presence of university extension in the city of Iporá (Goiás, Brazil), identifying the object and objective of the extension, the actors involved in the relationships, the target audience served and the perceived impacts on the location.

### IV. RESULTS AND DISCUSSION

Considering the research *modus operandi* shown above, this subtopic discusses and problematizes the main results and indicators achieved. At first, we sought to highlight the attributes present in the operational concept based on document analysis.

It is important to highlight the guiding role of this Forum of Pro-Rectors of Extension (FORPROEX) since its creation in 1987. Considering a lasting legacy of national discussions on the subject, FORPROEX constitutes a collegiate instance composed of those responsible for extension policies (in the figure of the pro-rectors of extension) who meet periodically to debate, propose, monitor, and evaluate the actions carried out in universities and federal education institutes across the country (JEZINE, 2006). Based on these prerogatives is that FORPROEX prescribes the principles and guidelines contained in the documents considered here.

Additionally, Resolution CNE/CES 7/2018, when dealing with the integration of extension in higher education in Extension in the curriculum matrix (at least ten percent of the total curricular workload of undergraduate courses), explains its interdisciplinary, political-educational character (cultural, scientific,

technological). Thus, the articulation of extension with teaching and research reinforces its potential for transforming interaction between higher education institutions and the communities in which they are inserted or within their scope.

A synthesis of the attributes found in this resolution, especially in Article 7 with the attributes present in the other documents analyzed, promoted a first characterization of the operational concept of university extension that guided the theme of extension relationships between Ifgoiano and the locality of Iporá in the period of 2017 to 2020, as illustrated in Table 1, which are instrumentalized in the form of 18 attributes that are configured as indicators of good extension practices.

- ♣ Practice linked to the demands of reality;
- ♣ Practice linked to meeting social needs (e.g., housing, food production, employment generation, and income redistribution);
- ♣ Practice integrated to a university conception that implies multidisciplinary, interdisciplinary, and/or transdisciplinary, as well as interprofessional relationships;
- ♣ Activity involving the relationship between the university and sectors of society;
- ♣ Practice that promotes the university's participation in the elaboration of public policies;
- ♣ Practice that promotes the establishment of the university as a legitimate body for monitoring and evaluating public policies;
- ♣ Practice that enables the institutional evaluation of the activities of the university itself;
- ♣ Ability to monitor public policies;
- ♣ Practice that promotes new means of production;
- ♣ Practice that promotes new means of innovation;
- ♣ Practice of expanding access to knowledge/knowledge;
- ♣ Practice that promotes the availability of knowledge;
- ♣ Practice that promotes the availability of education provision;
- ♣ Practice that promotes the use of technologies to improve the quality of education;
- ♣ Practice that promotes environmental education;
- ♣ Practice that promotes sustainable development;
- ♣ Practice that promotes the solitary action of the university for international cooperation;
- ♣ University initiatives are socially committed to all areas, especially communication, culture, human rights and

justice, education, environment, health, technology, production, and work.

The operational concept of extension activity presents the different dimensions emanating from the three basic pillars that guide the university's performance, which explains the contemporary role of higher education institutions.

In this condition, the Campus Iporá of IF Goiano is the main executor of extension projects in the locality whose regulations observe the principles of FORPROEX, since the pro-rector of extension of the institute is a full member of the collegiate, which are reinforced in Resolution CNE/CES 7/2018.

In the opportunity to scrutinize these conditions that interconnect the local to the national and the internal practices and perceptions of the external needs and demands in terms of extension, the manifestations of the interviewees about their conceptual understanding are that actors from the internal community of IF Goiano and actors were interviewed.

The extension activities reveal that the contents expressed in the speeches of the interviewed actors converge to part of the operational concept defined in this study. For this, a comparison of the terms and their respective meanings evidenced in the manifestations to the attributes of the operational concept was carried out to generate a conceptual and practical synthesis of the extension activities that take place in that locality. Thus, there is an effort to encompass both the aspect of formalized knowledge and the aspect of tacit knowledge (DÖRING; SCHNELLENBACH, 2004; ETZKOWITZ, 2001), providing a leaner list of attributes by bringing together some requirements (Practice promoting new means of production together with a practice that promotes new means of innovation, for example) and by suppressing items identified as unverifiable in the specific case (the case of the Practice promoting solidarity action by the university for international cooperation). Nine extension attributes were measured from the perspective of LED actors in Iporá:

- ♣ Initial and Continuing Training Courses;
- ♣ Meeting the demands of the community, especially the rural community;
- ♣ Improvement of people's quality of life through extension actions;
- ♣ Bringing the IF Goiano - Campus Iporá closer to the community;
- ♣ Extension as a means of transforming the region where it is inserted;

- ♣ Extension as a form of interaction between the internal community and the external community, with reciprocity regarding the exchange of knowledge;
- ♣ Benefits brought to the external community;
- ♣ Identification of needs in the community and, therefore, opening the institution so that this community seeks to resolve its needs within the institution itself;
- ♣ Staff qualification.

There is an understanding that the extension activities would effectively work as a bridge between the university and the community, permeating meanings, such as “approaching the IF Goiano - Campus Iporá with the community”, and extending through conceptions that emphasize the mutual gains provided by these activities. Interactions (“extension as a form of interaction of the internal community with the external community, with reciprocity with regard to the exchange of knowledge”; “identification of needs in the community and, therefore, opening the institution so that this community seeks to resolve its needs” in the institution itself”). There is also an aspect that points to a public policy character of local development linked to extension, as it is possible to infer through concepts such as “meeting the demands of the community, especially the rural community”, “improvement of people’s quality of life through extension actions”, “benefits brought to the external community” and “personnel qualification”.

A more precise meaning refers to “initial and continuing training courses”, a modality in which short-term vocational courses are offered, primarily aimed at serving the local labor market. Such courses, known by the acronym FIC, have been valued in recent years as an extension format encouraged by sectoral public policies such as the National Program for Access to Technical Education and Employment (Pronatec) and the New Paths Program. The view of several interviewees confirms this prominence:

*It has an important part which are these initial and continuing training courses. They are those courses for training professionals for a need that really exists in the city... baker, for example (interviewee n° 01).*

*In these courses, we seek to serve people who do not have access to education. Their objective is to qualify people with short courses to be able to enter the job market (Interviewee n° 04).*

It can be said that these designs help in understanding the meaning of extension as a “means of transforming the region where it is inserted”. In fact, there are different emphases, ranging from valuing FIC courses to civic and citizen training extension actions, including a focus on rural communities and family farming. But there is a common thread in all of them: the main idea that the region’s transformation necessarily involves differentiated support for populations in situations of socioeconomic vulnerability, corroborating to affirm that “Campus Iporá has been developing an extension activity”.

From this perspective, part of the interviewees considered the Thousand Women Program particularly notable, concerning the performance in the different areas of knowledge present in the daily life of that location:

*The Thousand Women Project is aimed at vulnerable women, identifying this audience through the Social Assistance Reference Center. Hence, we work first on self-esteem and then on specific technical training. Through it, we have already managed to create a large number of women who were in deplorable conditions and today have formal jobs; others have already returned to the school opened their own small businesses in Iporá. This is a project that has a very strong interface with the local and regional areas” (Interviewee No. 05).*

Certainly, the objective of promoting greater socioeconomic dynamism and improving the quality of life of the community (MORAES, 2016) is present here, having as a starting point the strengthening of interpersonal relationships and community bonds. Similarly, an effort to promote the dissemination of knowledge in a socially engaged way is observable, prioritizing the neediest people and valuing the beneficiaries’ previous experiences in the formatting/adaptation of the projects. That is, formalized knowledge and tacit knowledge are aligned in articulation between the macro and micro levels of interaction/relationship between the university and the external community, valuing preexisting potentialities and requalifying them with new approaches and possibilities built together (ARBO; BENNEWORTH, 2007; DÖRING;

SCHNELLENBACH, 2004). In the case of the Thousand Women Program:

*We promoted a salting course. We selected vulnerable women who, at times, had never worked but who knew how to cook. And this had a very positive impact because most of them didn't give up and learned a lot, giving them the opportunity to transform the skill of cooking (which many already had) into a profession. Since many of them actually work like this today... (Interviewee No. 19).*

According to another interviewee, extension actions with these characteristics are made possible through “an X-ray that we have shown the needs of the region, and so we have many projects to meet these demands” (Interviewee No. 04). Resuming the term of Döring and Schnellenbach (2004) that these relationships would be like positive externalities that flow from the university towards the community, a vision according to which these benefits would return to the university is evident: “the extension of Campus Iporá is very good for its role in bringing the campus closer to the community. And this community later becomes a defender of the campus” (Interviewee No. 02).

This support and social recognition, in turn, represents a validation of the relevance of the institution's role and the dialogue and negotiation of LED policies and strategies with other actors. In this sense, macro-level interactions/relationships are also strengthened in this scenario (HARLOE; PERRY, 2004). As a result, we empirically verify the adequacy of this theoretical approach in association with the operational concept of extension activity developed here, since the reality of the LED context signals a process of dynamization that has as one of its foundations the extension activities headed by the IF Goiano installed in the city of Iporá. In effect, the extension principles, guidelines, and attributes now advocated become, at the same time, supported and re-signified in the light of the extension activities developed in that locality.

## V. FINAL CONSIDERATIONS

As discussed, interactions/relationships resulting from university extension play multiple roles in the context of policies and strategies that condition local economic development (LED) processes. In this sense, it is

important to define attributes and indicators that allow understanding these phenomena and provide a consistent theoretical-conceptual and empirical framework for this purpose. The operational concept of extension activity elaborated here, based on the frameworks conceived by FORPROEX (2012; 2013) and Resolution CNE/CES 7/2018, can be applied to the specific case of Iporá from the perspective of LED actors working in the locality, which illustrates an exploratory process of validating a hypothesis regarding the promising contribution of extension activities and brings up important reflections.

Understandably, the combination of formalized knowledge and tacit knowledge seems to be a watershed in the achievement of extension activities since it presents itself as a way to strengthen interpersonal relationships and community ties, which are essential for the successful development of LED efforts. Furthermore, the centrality of giving priority to action in the different areas of knowledge present in the daily life of that locality by the institution studied and the pressing social demands are highlighted to make the reciprocal benefits of university-external community integration more important effectively recognized. In the context of a small municipality like Iporá, identifying this set of characteristics in the extension actions is congruent with a progressive socioeconomic dynamism highlighted by LED actors and adequately captured by the operational concept of extension activity developed here. Finally, these results are promising for a future research agenda covering replication in other locations and incorporating other attributes or even using them differently to assess trends and specificities in the light of other concrete cases.

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