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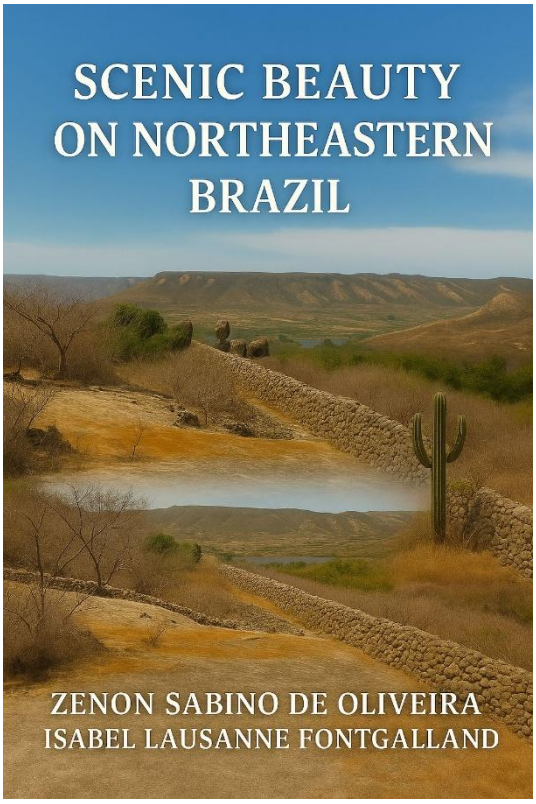

Zenon Sabino de Oliveira

Technium
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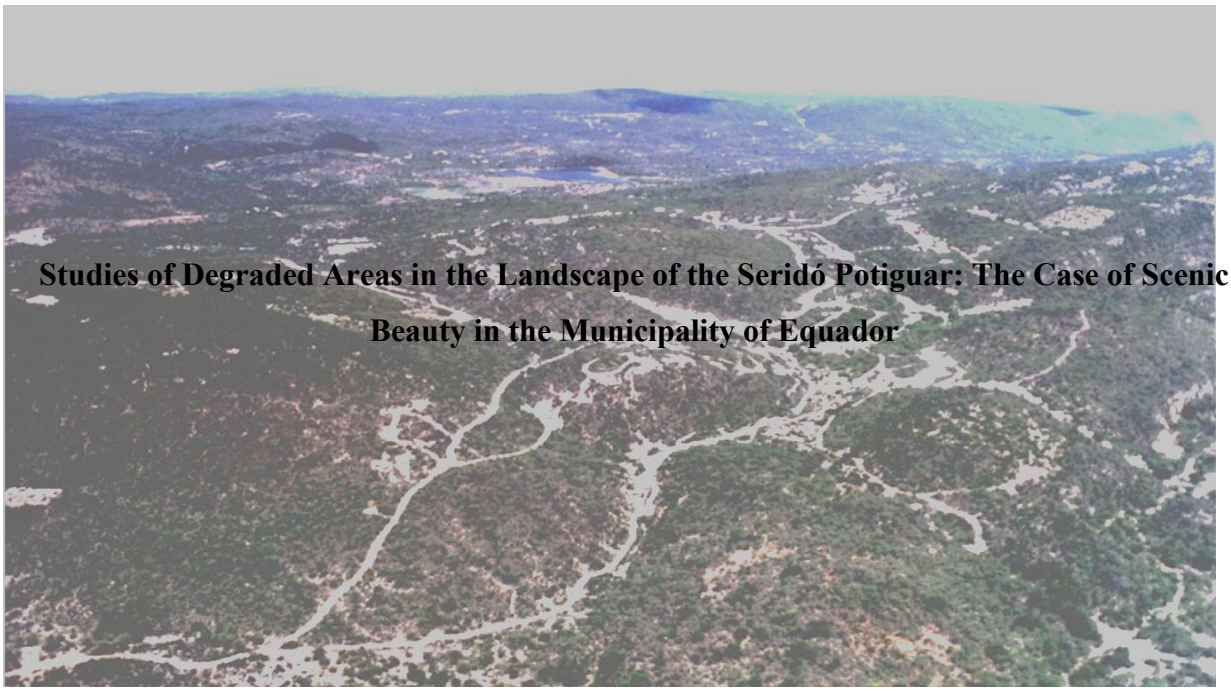

Studies of Degraded Areas in the Landscape of the Seridó Potiguar: The Case of Scenic Beauty in the Municipality of Equador

ZENON SABINO DE OLIVEIRA

Campina Grande, PB

February – 2025

ZENON SABINO DE OLIVEIRA

Studies of Degraded Areas in the Landscape of the Seridó Potiguar: The Case of Scenic Beauty in the Municipality of Equador

Thesis presented to the Postgraduate Programming Engineering and Management of Natural Resources, of the Federal University of Campina Grande, as a partial requirement to obtain the title of Doctor in Engineering and Management of Natural Resources.

Area of concentration: Natural Resources

Advisor: Professor Dr. Isabel Lausanne Fontgalland

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Zenon Sabino de Oliveira

"ESTUDOS DAS ÁREAS DEGRADADAS NO SERIDÓ POTIGUAR: O CASO DA BELEZA CÊNICA NO MUNICÍPIO DE EQUADOR."

Tese apresentada ao Programa de Pós-Graduação em Engenharia e Gestão de Recursos Naturais como pré-requisito para obtenção do título de Doutor Engenharia e Gestão de Recursos Naturais.

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The meaning of life consists in being in agreement with nature.

Zeno of Citium attributed by Diogenes Laertius in“Vitae Philosophorum”

Firstly, I would like to express my sincere gratitude to God forgiving mestrength and guidance to successfully complete this project. Secondly, I would like to dedicate this work to all my teachers who have played an influential role in shaping my academic journey. However, I reserve a special mention for Professor Dr. Isabel Lausanne Fontgalland, who has been my research advisor throughout this undertaking. She not only encouraged me during my interactions with her, but also patiently listened to and answered all my questions, which further strengthened my confidence in carrying out this research. I would also like to extend my thanks to my parents, especially Francisco Sabino de Oliveira (in memoriam) and Severina Batista de Oliveira. They have been pillars of support throughout life, providing me with valuable guidance when ever needed. Finally, I would also like to express my sincere thanks to my children Caio César Ferreira de Oliveira, Zenon Sabino de Oliveira Filhoand Francisco Sabinode Oliveira Neto, and to all the other dear brothers who were instrumental in making this project a reality.

I dedicate.

ACKNOWLEDGEMENTS

According to my life, the significant and central lesson I have got here distance should not think about accomplishing anything alone, and therefore we should value those who have helped in any way during our journey. Therefore, it is essential to recognize and give credit to the

people who have been present at all times. I admit that I am fortunate to have many

blessings in my life, but I am grateful to all the people and opportunities that have allowed me to

complete my doctorate.

First of all, I would like to extend my sincere thanks to all those who have

supported me throughout this arduous journey, whether directly or indirectly. It is with recognition that

I understand the role played by God in giving me strength and wisdoms at helped me to

achieve academic and professional goals, in addition to never letting me give up. Further more, I want to

express my gratitude to my family, including my late father Francisco Sabino de Oliveira,

my mother Severina Batista de Oliveira, my children Caio César Ferreira de Oliveira, Zenon Sabino de Oliveira Filhoand Francisco Sabino de Oliveira Neto, as well as my brothers and sisters, especially to my brother Erasmo Sabino de Oliveira, for his financial contribution to this research project, since I did not receive an exclusive scholarship for this undertaking.

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In addition, I want to express my gratitude to my graduate colleagues as well.

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who have always been by our side as mentors and have continuously guided us throughout our journey to maintain a harmonious relationship with the institution. Furthermore, I cannot conclude my speech without expressing my gratitude to UFC Gland the Coordination of the Unit Academic Geography for granting me partial release to carry out academic activities additional during my doctorate.

ABSTRACT

This thesis explores the meaning and importance of the scenic beauty of landscapes, the criteria of landscape quality, the bases of environmental protection at national and international levels, in addition to presenting a methodological tool to identify the beauty of landscapes in the Biome Caatinga, located in the Seridó of the state of Rio Grande do Norte, with emphasis on the municipality of the city of Equador, taking into account the processes of environmental degradation resulting from activities of mineral extraction. For this, during my period of doctoral studies in the Postgraduate Programming Engineering and Natural Resources of the Federal University of Campina Grande, theoretical and methodological foundations were obtained through bibliographic research and analysis of current legislation, considering a qualitative study and exploratory involving the Caatinga Biome. The results highlight that the scenic quality of landscapes can be assessed both objectively and subjectively, identifying scenarios that require protection due to their aesthetic and environmental value, contributing to the natural and cultural heritage of the country and for the well-being of local communities, also dealing with also a social and economic issue. Each peculiar type of geological formations and geomorphologic features that make the area so picturesque were shaped throughout the history of the Earth.

Such characteristics are recorded in the landscape in different forms of relief, and the dissection has already been susceptible to landscape analysis. Another objective is to discover the degradation potential of the landscape in the landscape analysis process. Therefore, certain concepts and methods are used. The Seridó scenario will be presented and will address the need for the techniques, analyzing mining and ceramic activities. Thus, the objective is to provide essential information to minimize the damage caused to pegmatite deposits in the Equador Geological Formation. Most of the sediments in the locations are composed of waste that is discarded into the environment without any order, with the exception of a small percentage that has commercial value. An approach will be mentioned through the

environmental mosaic proposed for the space. Landscape ecology is defined as the science that studies the landscape mosaic. There are two main approaches: the geographical, which studies the human factor in the control of the landscape and territories, and the ecological, which is concerned with the spatial factor, important for the dynamics and functioning of ecological processes and for the conservation of biodiversity. Therefore, a landscape is defined as “a mosaic heterogeneous units in interaction with at least one factor of heterogeneity, depending on the observer and the scale of observation.”Another aspect of the thesis research says respect to the desertification process of this nucleus of Seridó Potiguar. In Brazil, the extreme soil degradation and human pressure have led to severe degradation in the caatinga seridoense, also known as the center of desertification. Fires, cotton cultivation in the past, pasture and firewood extraction have altered the physiognomy of the vegetation, making it, in its majority, extractive and originating extreme droughts. Thus, this study was based on techniques regular multivariate to discover the extent of degradation of the coating fragments of the Seridó.

Keywords: Scenic Beauty; Landscapes; Degraded Areas; Environmental Impacts; Desertification; Caatinga Biome; Environmental Mosaic.

ABSTRACT

This thesis explores the meaning and importance of the scenic beauty of landscapes, the criteria for landscape quality, the bases of environmental protection at a national and international level, in addition to presenting a methodological tool to identify the beauty of landscapes in the Caatinga Biome, located in Seridó of the State of Rio Grandedo Norte, with emphasis on the municipality of the city of Ecuador, taking into account the processes of environmental degradation resulting from mineral extraction activities. To this end, during my period of doctoral studies in the Postgraduate Programming Engineering and Natural Resource sat the Federal University of Campina Grande, theoretical and methodological foundations were obtained through bibliographical research and analysis of current legislation, taking into account tells a qualitative and exploratory study, involving the study of the Caatinga Biome.

The results highlight that the scenic quality of landscapes can be assessed both objectively and subjectively, identifying scenarios that require protection due to their aesthetic and environmental value, contributing to the country's natural and cultural heritage and the well-

being of local communities. It is also a social and economic issue. Each peculiar type of strange geological and geomorphologic formations that make the area so picturesque has been budgeted throughout Earth's history. Given that they a rerecorded in the landscape indifferent forms of relief, the dissection has already been made susceptible to landscape analysis. Another objective is to discover the potential for landscape degradation in the landscape analysis process. Therefore, certain concepts and methods are used. The Serido ensue scenario will be presented and the need for such techniques will bead dressed, addressing mining and ceramics activities. Thus, the aim of the restudies is to provide essential information to minimize the damage caused to pegmatite deposits in the Ecuador Geological Formation. Most of the sediments in the selocations are made up of waste that is sent in to the environment without any order, with the exception of a small percentage that has commercial value. One approach will be mentioned through the environmental mosaic proposed for the space. One approach will be mentioned through the environmental mosaic proposed for the space. Landscape ecology is defined as the science that studies the landscape mosaic of landscapes. There are two main approaches: the geographic one, which studies the human factor to control the landscape and territories. The other is ecological, which is concerned with the spatial factor, which is important for the dynamics and functioning of ecological processes and for the conservation of biodiversity. Therefore, a landscape is defined as “a heterogeneous mosaic of interacting units with at least one factor of heterogeneity depending on the observer and the scale of observation”. Another factor regarding the thesis research concerns the desertification process of this nucleus of Seridó Potiguar. In Brazil, extreme soil degradation and human pressure have led to extreme degradation in the Caatinga Seridoense, also known as the center of desertification. Fires, cotton harvesting in the past, pasture and firewood extraction have changed the physiognomy of the vegetation to being mostly extractive, causing extreme droughts. Therefore, this study was based on regular multivariate techniques to discover the extent of degradation of fragments of the Seridó Caatinga.

Keywords: Scenic Beauty; Landscapes; Degraded Areas; Environmental Impacts; Desertification; Caatinga Biome; Environmental Mosaic.

"Me andthe Sertão"

Patativado Assaré

Sertão, someone sang to you,
I have always sung
And I'm still singing,
Because, my beloved land,
I greatly cherish you, I love you
And I see that your mysteries
No one knows how to decipher.
Your beauty is so great,
That the poet sings, sings,
And there is still something to sing.

SUMMARY

LIST OF ABBREVIATIONS AND ACRONYMS

ABNT – Brazilian Association of Technical Standards

AEM – Millennium Ecosystem Assessment.

AIA – Environmental Impact Assessment.

AIDS –Acquired Immunodeficiency Syndrome.

APA – Environmental Protection Area.

CDB – Convention on Biological Diversity.

CFC – Chlorofluorocarbon.

CIM –International Mapofthe Worldatthe Millionthscale.

CNUMAD –United Nations Conferenceon Environmentand Development.

CONAMA – National Environment Council.

COP 10 –10 th Conferenceofthe Partiestothe Conventionon Biological Diversity.

CPRM – Mineral Resources Research Company.

DNPM – National Department of Mineral Production.

DOC – Dissolved Organic Carbon.

EC –Electrical Conductivity.

EIA –Environmental Impact Study.

EMBRAPA–Brazilian Agricultural Research Corporation.

EMPARN –Rio Grandedo Norte Agricultural Research Company.

EPI – Personal Protective Equipment.

FAO –Foodand Agriculture Organization.

GIS – Geographic Information System.

GPS –Global Positioning System.

HIV – Immunodeficiency virus.

IAIA –International Associationfor Impact Assessment.

IALE –International Associationfor Landscape Ecology.

IBGE –Brazilian Instituteof Geographyand Statistics.

IBRAM – Brazilian Mining Institute.

IDH –Human Development Index.

INCD –Intergovernmental Negotiating Committee.

ISO –International Organizationfor Standardization.

IVE –Ecological Vulnerability Index.

MBL –Marine Biological Laboratory.

MIT–Massachusetts Institute of Technology

NEPA – National Environmental Policy Act

MDGs – Millennium Development Goals

SDGs – Sustainable Development Goals

NGOs – Non-Governmental Organizations

UN – United Nations

NAPCD – National Action Programme to Combat Desertification

GDP – Gross Domestic Product

PRAD – Degraded Areas Recovery Plan

PES – Payment for Environmental Services

RAPPAM – Rapid Assessment and Prioritization of Protected Area Management

GIS – Geographic Information System

SNUC – National System of Conservation Units

SRTM – Shuttle Radar Topography Mission

SUDENE – Superintendency for the Development of the Northeast

PAs – Protected Areas

UNCCD – United Nations Convention to Combat Desertification

UNCED – United Nations Conference on Environment and Development

UNCOD – United Nations Conference on Desertification

UNESCO – United Nations Educational, Scientific and Cultural Organization

UNEP – United Nations Environment Programme

UNSO – United Nations Sudano-Sahelian Office

IALE – International Association for Landscape Ecology

WWF-BR – World Wide Fund for Nature – Brazil

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CHAPTER I

RESEARCH CONTEXTUALIZATION

INTRODUCTION

Since ancient times, human beings have always been fascinated by the beauty found in nature, feeling that in it they would find happiness and be satisfied. Human captivationnormally revolves around inspiring landscapes, which not only capture our attention, but also underline our dominion and communion with the surrounding world. In chapter 4 we will examine different views on natural scenic beauty, presented and examined by different writers who consider it enchanting or peculiar for its uniqueness.

One of the main objectives of this thesis is to evaluate the aesthetic quality of the landscape of the Seridó Potiguar Biomein Rio Grandedo Norte. This location has suffer severely at the hands of environmental destruction; certain areas can not be repaired and are irreversible. Its main objective is to provide knowledge that helps to better understand these issues. When it comes to the Sustainable Development Goals(SDG-15), predation can be considered a component of natural regulation, while conservation is mess it as the denial to future generations of an opportunity to know, appreciate and understand natural history. The beauty in her dentin the natural gift of the earth varies according to preferences personal. Generally, however, we are amazed by beautiful places due to their size and how they form naturally. “Landscape” is a word that suggests a image of what we see before us–like peeking through a window at untouched nature.

But landscapes can be much more than just visual; they can also be mirrors that reflect some culture or history of a people. The level of well-being and content mentin a society is, in fact, considered the result of the relationship that exists between how happy and satisfied people are with themselves physically and mentally. However, the activity human in harmony with nature consequently gives the opportunity to find that harmony between utility and pleasure.

Therefore, it is assumed that there is a link between the social level of well-being and happiness and the way individuals feel at peace with themselves, psychologically and physically. A adequate balance between pleasure and benefit is felt by people as a result of the interaction mutual between the activities of man and nature. Protected areas originate from conservation that emphasizes biodiversity and scenic beauty. Over time, the strategies implemented for these remarkable places have evolved considerably. Legislation ensures that this natural beauty remains unchanged through international recognition, sanctioned by bodies such as the United Nations Educational, Scientific and Cultural Organization(UNESCO). The National Systemof Conservation Units(SNUC) and the inventory are two legal measures for landscape conservation in Brazil. The ability to analyze the characteristics of the landscape and conservation mechanisms is very important in the management of territories, particularly those with immense natural resources, a vast cultural diversity and a geographical space recognized throughout the world. Desertification is another reason that makes this region highly vulnerable from an environmental point of view. In this work, the focus is on the Caatinga Biome and its stunning scenarios, trying to say that poverty or backwardness are not names applicable to this territory, which unfortunately is frequent presently. The places are not devoid of life and hostile. In some areas, such as the Seridó Potiguar, degeneration is observed due to human interference, especially in some municipalities, due to the environmental impacts caused by mineral extraction. The activity related to mining and the mining industry is crucial for our economy and society; however, its technical effects, which degrade the environment, are harmful and must be controlled so that measures are taken to minimize the damage caused to nature. The degradation of the environment, resulting from human actions, is widely recognized, negatively affecting the quality of water, air, soil and is revealed in a set of statistical data that demonstrate the magnitude of this degradation. Next, some statistics and appropriate sources are presented to corroborate this argument: water degradation, since more than 80% of global waste water is discharged into the environment without treatment, contaminating rivers and oceans, originating the entropy processing 40% of the water bodies in the United States, where it accumulates nutrients (such as nitrogen and phosphorus) from agricultural fertilizers and

sewage, plus micro plastics, an estimated 10 million tons of plastic in 2015, affect 88% of species marine; shortage of safe drinking water; air degradation, desertification and erosion. The interconnected consequences affect biodiversity, 1 million species threatened with extinction, a consequence of habitat loss, pollution and climate change; from the economic bias, it is estimated a loss of 4.7 trillion US dollars per year in services ecosystemic (such as pollination and climate regulation). Therefore, the quantitative data confirm that degradation is systemic and accelerated, requiring an immediate boost in policies, such as: transition to renewable energy sources; strict control of pesticides; and application of resources in basics an citation and ecosystem restoration essential. This scenario also applies to mining activity, which harms the environmentand compromises the development of future generations at different times. However, paradoxically, such activities are essential to generate jobs and profits that avoid the immediate need to seek alternatives. Mining involves the significant extraction of soil from the earth's crust, resulting in the exposure of vulnerable and fragile areas. This practice entails series of impacts along the production chain, leading to the degradation of areas affected by deforestation and other significant impacts on the environment. The effects secondary included a mage to human health, as well as damage to the environment and living conditions. Chapter 15 addresses the analysis of environmental impacts caused by mining, with special focus on the extraction and processing of kaolin and other activities minerals.

INNOVATION AND ORIGINALITY

This doctoral thesis is a milestone for science : it delves in to a topic that is still little explored in universities and proposes fresh ideas, creative methodologies and a new look to the area. The big difference? How it mixes theory and practice, weaving a rich analysis and connected, like pieces of a puzzle that finally fit together. While previous studies followed known formulas, this research brings a revolutionary method. There salts not only challenge what was already known, but also open totally new paths for science– like an academic GP Pointing routes unexplored. The originality is in the details: data collected for the first time, analyzes that question the obvious, and conclusions that make

the scientific community rethink old certainties. Here, scenic beauty and environmental recovery take on an demeaning. The work challenges out date did easy about landscape an ecological impact, focusing on the transformation of degraded areas of Seridó Potiguar– especially in the city of Equador, in Rio Grandedo North. While other researchers were limited to conventional (and sometimes stiff) methods, this thesis advances with modern techniques, cutting-edge technology and a lot of creativity. The result is a pioneering theoretical and methodological model, some thing that will inspire research for the next decades.

The secret? The unprecedented combination of knowledge. The research mixes geography, ecology, art and technology in a way that no one had tried before. This mix true not only expanded the possibilities of study, but also created a standard for understanding the relationship between landscape and society. And the best part: by uniting environmental and human sciences, the work became a bridge between disciplines, generating practical and–why not say?–poetic solutions for real problems.

The scientific originality lies in the unique combination of concepts, allowing to explore the theme from never be for articulate dangle. This methodological innovation not only broadened the scope of the research, but also redefined standards for future studies. Furthermore, the interdisciplinary was fundamental: by connecting areas such as environmental sciences, geography human and geospatial technologies, the study generated insights that renewed the dialogue between natural and human sciences. This synergy between distinct fields resulted in practical solutions and creative, showing how the integration of knowledge can transform local realities. On the theoretical level, the thesis proposed a new taxonomy to classify phenomena emerging in dynamic systems, overcoming the rigidity of classical models by incorporating socio-environmental variables in real time. Finally, the thesis is a historical gap in the literature by offering an integrated framework that synthesizes decades of robust fragmented research. A analysis of exclusive data, guaranteed an empirical basis, ensuring that each conclusion challenged things as they are with rigor and creativity. This thesis was born from a poetic and scientific challenge: to reimaging the relationship between beauty scenic and environmental regeneration in the heart of the Seridó Potiguar. By focusing on landscapes resilient of Ecuador, located in the Caatinga Biomeof Rio Grandedo Norte, we proposed a silent revolution – transforming degraded areas not through brute interventions, but listening to the landscape's own language. While the world discussed metrics conventional environmental impact, we got lost (and found ourselves) in the details: in the curve of a seasonal stream, in the texture of the

reborn coating, in the dialogue between rocks millennial and contemporary communities. Breaking with traditional paradigm are quirked more than courage–we need to invent a new vocabulary. We developed methodologies as flexible as the ecosystem that we studied, combining the rigor of satellite data with the wisdom of family farming masters family. Each applied technology was adapted to the unique scars and beauties of the region, transforming limitations into creative opportunities.

The numbers we collected? They are witnesses to a secret: the degraded landscape holds within itself the memory of its own cure. True innovation a rose at the frontiers between disciplines. When we unite the poetics of the humans incest with environmental pragmatism, we discover something magical: scenic beauty is not just aesthetics, it is a vital indicator of ecological health. We built a new way of classifying environmental phenomena that incorporates the pulse of local communities–where a farmer harvesting umbel becomes as crucial a variable as soil moisture. This tax one my alive, updated in realtime, challenges therigid models ofthe past asthe caatinga challenges the drought: with intelligent adaptation.

The results? They are seeds planted in multiple soils. In academia, we offer a map to decipher landscapes as dynamic systems. In public policies, we demonstrate that environmental regeneration and cultural appreciation can be faces of the same currency. For Ecuador, weleaveaconcretelegacy: proofthatbeautyisnotaluxury, but powerful tool for socio-environmental transformation.

This journey is not over–in fact, it has barely begun. Each discovery generated new questions, each method created asks to be improved. May this thesis be read as a diary logbook: full of scribbles, hand written corrections and marginable epiphanies. After all, doing science in semi-arid lands requires more than precision– it demands the audacity of those who know that even in the soil driest can sprout, unexpectedly, amend a cornflower.

JUSTIFICATION

The object of the research is the Caatinga Biomein Seridó Potiguar, and investigate show beauty scenic in fluencies territorial management, as well as its consequences on the landscape. The arrival of the colonizers caused the degradation of the Atlantic Forestand affected the regions of Agresteand Northeastern Sertão. In this investigation, we will analyze the beauty of the landscapes using laws of environmental protection, along with a map that assesses the beauty of the caatinga found in Ecuador-RN. Thus, one of the

objectives of this research is to investigate the link between visibility in protected areas and their beauty in relation to aesthetic values in urban planning, as well as the mining activity, which plays a role of impacts, such as kaolin. The environmental damage related to mining is mainly characterized by deforestation and soil erosion. If we want to correctly determine this verity of these transformations, we must observe them, assess how they develop and measure their values through them. If a region does not regenerate within a set period of time, it is considered a degradation that requires human intervention. It is necessary to carryout actions with the aim of restoring the conditions of a degraded or altered natural environment to a ability to accelerate regeneration, in some cases, excessive degradation and loss of resilience can lead areas to an extremely low state of recovery. During kaolin beneficiation processing, waste water is usually discharged into rivers, while solid wasteis disposed of in landfills nearby to the plants. These wastes consist of metals such as iron, aluminum, zinc and cadmium, in addition to legally permitted levels, with traces of impurities. The consequences of such contamination is not limited only to the immediate pollution of the ecosystem, but also impact the topography, flora, fauna habitat, water and soil quality. A fundamental connection between the scenic landscapeand the local environment, as well as human activities, exerts great influence on the overall appearance of the biome; consequently, this research intends to emphasize this interaction. The creation of areas protected areas integrated with human well-being and that can be transformed into sources of socioeconomic benefits should take into account the value of the natural landscape, while territorial planning contributes to the maintenance of aesthetic excellence in the Caatinga Biome, especially in the surroundings of Seridó Potiguar, with unique landscapes throughout the world. To assess the environmental implications of human activity in the caatinga, specifically in Seridó Potiguar, located in the state of Rio Grande do Norte, the suggested and applied approaches will be critical. The compromising factors for this region include air, soil and water quality. One aspect of the research that we are proud of is that we are the first to conduct a study on the identification of environmental impacts on beauty of natural reigning the caatinga forests of northeastern Brazil, especially in the region of Seridó, in Rio Grandedo Norte. In this context, the present investigation seeks to contribute scientifically with knowledge that does not yet exist and explore unexplored

domains. Some of the studies in the area of environmental impacts and degraded are a scarried out in this region include those that deal with the consequences of kaolin exploration in the municipality of Equador-RN, by Lima(2010). In her master's dissertation, Silva(2017) emphasizes the kaolin extraction activities and their environmental and social repercussions in this same municipality. In his study, Silva (2007) addresses the problems related to red ceramics and its production processes, as well as environmental considerations. Meanwhile, the investigation of the landscape and scenic aesthetics has not yet begun, but a theoretical basis for future research will be launched from the premise of this study.

OBJECTIVES

General Objective

Our objective is to determine how the use of space and housing are changing in the Caatinga Biome, with special attention to the Seridó Potiguar, and mainly in the municipality of Equador-RN, due to environmental impacts directly interfering with the scenic beauty of the landscape.

Specific Objectives

Explain how natural capital interferes with the resources of the area under study; identify the changes that occurred in the studied area between 1980 and 2020, using georeferencing; explain when, how and why society began to perceive the need to protect landscapes, especially the beautiful ones; identify the possible socioeconomic consequences of the land use model adopted in the Caatinga Biome region of Seridó Potiguar; investigate the environmental and visual impacts caused by transformation sand interventions, mainly in the mining sector, in the region's scenario; and present options to protect and take advantage of areas of scenic beauty in Seridó Potiguar.

CHAPTER II

LOCATION OF THE RESEARCH AREA

The area of Seridó Potiguar has had mining as the central basis of progress since the colonization period, which generated undesirable effects on the natural components of the Biome Caatinga. Our choice to carry out this study was based on the fact that Equador-RNis located in Seridó Potiguar and, therefore, is an important region of the caatinga, a territory that experiences radical transformations in the ecosystem, mainly due to mining. To carry out this research, we decided to study the municipality of Equador-RN, which is within the range of these geographical coordinates: Latitude 06° 47' 00" S and Longitude 036º 46'00"to 036º33'W. Its total area is 264 km. The climate here is semi-arid and, on average, per year, varies around 23°C; however, January is the hottest month. The location of the city is expressed through Figures 1 and 2, respectively.

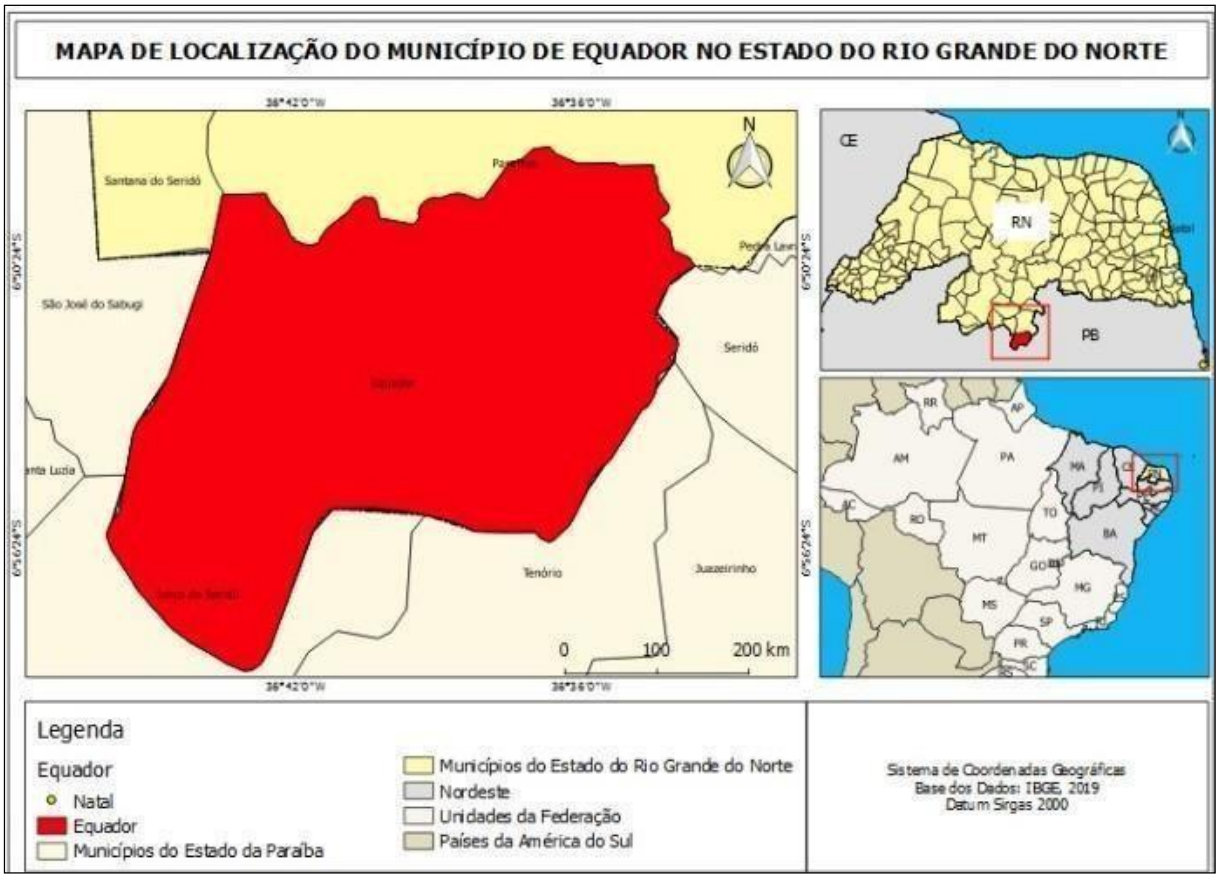

Figure 1 – Location of the city of Equador-RN. Source: own author ship based on IBGE(2019).

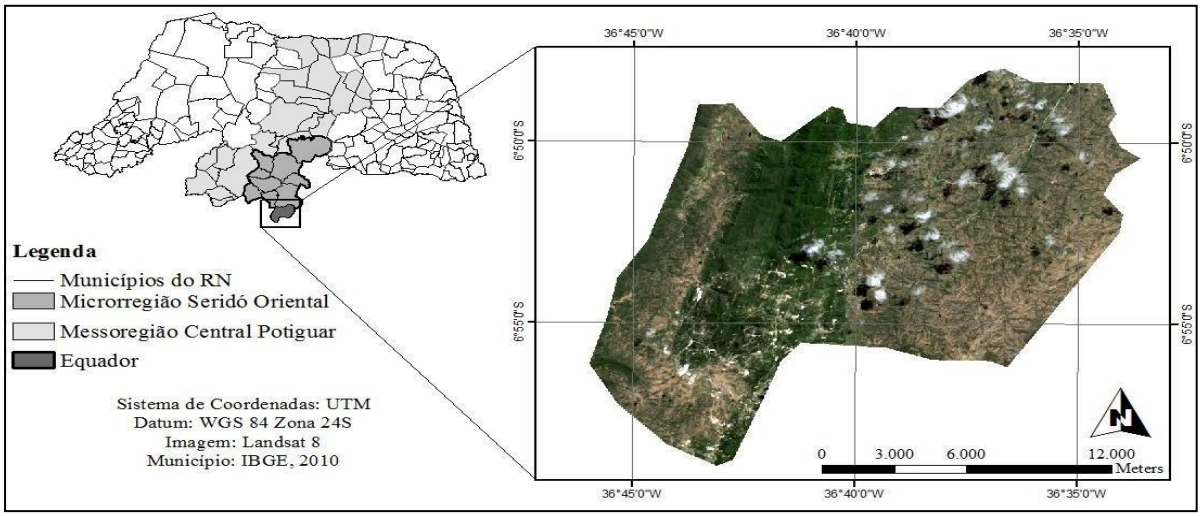

Figure 2 – Political location of the city of Equador in the Seridó Region. Source: Silva (2017).

CHAPTER III

METHODOLOGY

DEVELOPMENT OF THEORETICAL-CONCEPTUAL, METHODOLOGICAL, AND OPERATIONAL PROCEDURES

The construction of theoretical-conceptual, methodological, and operational procedures is divided into two major groups: theoretical-conceptual procedures and methodological and operational procedures. Each group is composed of a set of actions, as shown in the flowchart in Figure 3.

Figure 3 – Theoretical-Conceptual, Methodological, and Operational Procedures. Source: self-elaboration (2023).

The theoretical-conceptual procedures consist of a bibliographic analysis aimed at the survey of theories and concepts, capable of substantiating the research. When doing a bibliographic research, the researcher is not just repeating what has already been said, but rather forming their own conclusions based on the information they found. It's as if he were becoming a detective, investigating and discovering new insights about the theme.

Proposing to execute an arc of investigative in query with the argumentation of the elements philosophical aesthetics aiming to delimit the notion of landscape aesthetics, to the concepts of landscape in manage men tend heritage protection instruments in order to delimit the concept of "scenic quality of the landscape" and its instruments and methodologies of valuation and perception. Finally, a vast area of application is delimited, such as the Caatinga Biome, specifically the Seridó Potiguar. In the field of visual beauty and aesthetics, the beautiful, the sublime and the picturesque are defined from the roots of aesthetic study to the theories formulated by philosophers of Western thought. The ideas of numerous philosophers such as Plato, Aristotle, Portino, Saint Augustine, Saint Thomas Aquinas, John Locke, David Hume, Alexander Baumgarten, Euch Videl Price, William Gilpin, Richard Knight, Edmund Burke, Immanuel Kant, George Hegel and Edgar Kirchhoff will be analyzed. The theoretical foundation of landscape beauty will be through its writers who understand landscape beauty and natural beauty. These writers have knowledge aesthetic and scientific about the landscape and they are: Georg Simmel, Joachim Ritter, JoséMaría Sánchezde Muniain, Ronald Hepburn, Rosario A. Sonto, Nicolas Grimaldi, Alain Roger, Augustin Belk, Eugenio Turi, Alan Carlson, Eureko Saito, Malcolm Bader, Arnold Bo Lint, Martin Searle, Paulo D'Angelo, Luisa Bonesioand Gonzalo Ribeiro Telles, Alexandervon Humboldt and Johann Wolfgang von Goethe. Following, it explain show landscapes, especially panoramic ones, began to awaken the need for conservation in society, addressing the protection of values historical and natural, the creation of protected areas, the protection of artistic beauty, the historical recognition of Brazilian landscapes and related terminology. The beauty of the landscape is the result of the analysis of the technique soused to identify the natural beauty, but also included the patterns, basic components and factors that influenced the perception of a landscape. The geodiversity and biodiversity of the Caatinga Biomein Rio Grandedo Norte, highlighting the natural beauties found in the area. To build a solid foundation, various sources such as books, articles were examined scientific papers, theses, dissertations, treatises and laws from different countries, as well as conversations with specialists in the area of focus of the study. In the elaboration of the methodological procedures, the approach to the criteria for the application of the Vegetation Index (IVE) and the limitations of remote sensing

are evidenced through remote sensing, showing that spatial and temporal resolution is important to choose the right photos; high resolution ones help to see every thing distinctly. Correcting the atmosphere is crucial to avoid distorted images, and using multiple photos over the time helps to see changes in vegetation. Checking the data with what you see in the field is essential to be sure of the results. But remote sensing hasits problems: the climate get sin the way, the colors you see are limited, it's hard to tell things a part and the terrain influences. More data is needed and the speed at which satellites take pictures is not always helps. In short, the IV Eis good for taking care of the environment, but it only works if you follow the specific rules concerning the application of this study.

ORGANIZATIONAL STRUCTURE OF THE THESIS

In order to facilitate the reading of the thesis, the text of the same will be arranged in 16 chapters.

In Chapter I–Introduction: the contextualization of the problem addressed will be presented, the main hypotheses and objectives of the work, as well as the organizational structure of the thesis.

In Chapter II – Research Location: the text offers a complete overview of the Caatinga Biome, with special focus on the Seridó Potiguar region, aiming to explore the details of this unique ecosystem and understand how it works. The Seridó Potiguar is an area within this biome, located in the state of Rio Grande do Norte.

In Chapter III–Methodology: the methods and procedures used are presented for data collection.

Chapter IV–Theoretical Framework: in this chapter, therefore, the landscaper elevance for mental well-being will be observed: a study of appraisals and effects psychological. Beauty is a component of landscape appreciation that is not limited to its visual characteristics, being intrinsically linked to human satisfaction. The preservation landscape is essential for environmental maintenance, as well as for biological diversity that guides environmental sustainability. In addition, landscape beauty stimulates research scientific, environmental education and environmental awareness. Landscape

beauty also stimulates leisure activities that provide a feeling of relaxation and refuge fundamental to mental well-being. The beautiful landscape is not just about well-being visual; it influences different aspects of the human experience, being an important contribution to mental well-being.

Chapter V–Studyof Landscapeand Nature: where the landscape and the picture of nature in Humboldt and Goethe will be addressed in this chapter. The visual and artistic representation will be mentioned and thus how it has stood the test of time and influenced the literature and art of Germany in the 18th and 19th centuries. Therefore, it is relevant to examine briefly some of the works of the set worriers who highlighted the landscape in their reflections: the poet Johann Wolfgang von Goethe, and the natural scientist Alexander von Humboldt.

In Chapter VI–The Protectionof Natureand Landscape: a vision of conservationism, this chapter focuses on the protection of nature and the landscape, taking into into account a view from the point of view of conservationism, where preserving nature is fundamental to balancing the protection of ecosystems with the rational use made by human beingshuman. Widely supported by environmental advocates, this approach will seek establish sustainable models that guarantee the well-being of current and future generations. Your the objective is to avoid the depletion of natural resources and guarantee their availability in the future, including the creation of protected areas for delicate ecosystems. Preservation is a branch of conservation that emphasizes the protection of nature regardless of its economic value and holds human activities responsible for the degradation of ecosystems. The objective of protection and preservation is to safeguard biodiversity and encourage development sustainable, reconciling protection with the use of natural resources.

In Chapter VII– Currentsof Environmentalism: preservationism and conservationism, the dichotic between preservation and conservationism will be explored in the environmental movement: a comparative analysis of environmental ideologies. Protection andpreservation play essential roles in the environmental movement, each with its own particularities and specific objectives.

Chapter VIII – Aspects of the Natural and Economic Space of the Area under Study: aims understanding how natural and economic factors relate in a specific area of study is

a complex task that demands a detailed analysis, in this way the aspects of General Geology, geomorphologic, physiographicand Economic Geology/Geography of the researched space.

Chapter IX–The Caatinga Biome: the most beautiful landscapes of this biome are composed by a diverse range of plant formations, types of rocks, variations in altitude and alone. The caatinga has some unique characteristics, mainly with regard to how plants and animals adapt to the climate. The semi-arid biome goes through long periods without rain, which can make it difficult for plants and animals to survive. As there is not much vegetation, plants need to find ways to survive. They are very diverse and can adapt to different climates, such as moving during the dry season. In this chapter, an impact on this biome is verified, caused by human action.

Chapter X–Proposalfora Mosaic Appliedtothe Caatinga Biomeof SeridóPotiguar: this study seeks to formulate a concept of mosaic as a conservation tool that could combine sociocultural, political-economic aspects with environmental conservation on a bioregion scale. The Caatinga Biome is home to the highest level of biodiversity on Earth, but is the victim of environmental deterioration caused by several factors, including activities humans, such as the uncontrolled exploitation of natural resources.

Chapter XI – Impacts and Environmental Degradation to the Detriment of Scenic Beauty: thischapter will address the impacts arising from environmental degradation as opposed to beauty scenic in Seridó Potiguar, notably in the municipality of Equador-RN, as a result of activities mainly of mineral extraction, where the felling of trees in areas forests inevitably alter the scenic beauty of the landscape, significantly impacting the aesthetic appeal and environmental quality of the surroundings. However, there is hope of restoring this beauty overtime through natural regeneration processes or interventions that aim to promote the recovery of ecosystems. It is expected that overtime and appropriate treatments, the scenic beauty of deforested areas can be reconstituted, allowing us to rescue the natural charm that was lost during the degradation process. To implementing sustainable solutions and conservation efforts, it is possible to mitigate the impacts negative effects on scenic beauty and promote the long-term preservation of environmental aesthetics in degraded areas.

In Chapter XII–Brief Historiographyofthe Mineral Sectorofthe Brazilian Space: in this chapter, we will seek to historicize, in a brief space of time, the evolution of the sector Brazilian mineral, from activities originating from colonial mining, to the dawn of evolution in a historical analysis of the Evolution of the Brazilian spatial mineral sector, giving emphasis on trends, developments and impacts, going through a series of transformations over the years, historically occupying a significant position in the global market of mining.

Chapter XIII – Overview of Recovery of Areas Degraded by Mining/General Characteristics of Mainlining Brazil and the Environment: the activity of mining, for the most part, causes environmental disasters in which theorize moved is not returned to its place of origin, causing what can be described as waste land. This chapter of the research will discuss how mining companies and mining activities address the problems of this region. This will be discovered through various aspects of the process, including environmental law and the destruction of natural factors. Furthermore, as the recovery of these sites is necessary for the preservation of the environment and the maintenance of the economy, it is vital to discuss it. Mining is a temporary process and, once explored, must be recovered for future use.

Chapter XIV–Geographic Information Systemsand Remote Sensing Applications Remote for Ecosystem Management to Monitoring in the Study Area: the use of space technology is increasingly common in people's daily lives, offering more opportunities than backwards. It can be used to make all aspects of the operation more effective and streamline existing resources. Therefore, the objective of this chapter is to investigate how geographic information systems can be used to monitor and support the recovery of regions damaged by mining.

Chapter XV–Environmental Impacts Causedby Kaolin Extractioninthe Municipality of Equador/RN: the purpose of this chapter is to examine the environmental effects of kaolin extraction in the city of Equador, state of Rio Grandedo Norte, where this study will address the current situation of mining and mineral processing in the area, verifying that although it has helped local economic progress, it has been evidenced that this activity has brought harmful consequences to the environment, this being the main focus of the investigation. Another factor arising from the impacts caused in the space concerns

the process of desertification caused by human action, in the desertification nucleus of Seridó Potiguar, located in the Northeast of Brazil, where mainly anthropic factors have been facing a serious desertification crisis caused by inadequate land use and economic activities that are depleting vegetation and water resources. The economy local has caused serious disturbances, compromising the native vegetation. In the last 32 years, there have been significant changes in the way land is used in the region, largely partly due to past and present economic activities. Unsustainable are observedeconomic models, mainly with mineral exploration, where satellite images and field research reveals that some areas have already lost their fertility, while others are at imminent risk of desertification.

Chapter XVI–Final Considerations: in this part of the thesis, the objective sand conclusions achieved throughout the investigation process are carefully reviewed. The highlight here how this makes it possible to advance knowledge in the area of research, both practical and theoretically. Similarly, this chapter discusses the limitations and weaknesses of the study along with some suggestions for future research. It is not only a recapitulation of the own research, but also ends with a personal reflection on learning and the investigation process itself. The critical relevance of the results obtained during the research in the field of study will be emphasized and possible practical applications and future directions for subsequent search will be presented. Highlighting the scientific innovations significant from the point of view of the unprecedented study of the research.

The chapters that make up the organizational structure of the thesis are represented below in the flowchart of Figure 4, which will be used to organize all the content of the work.

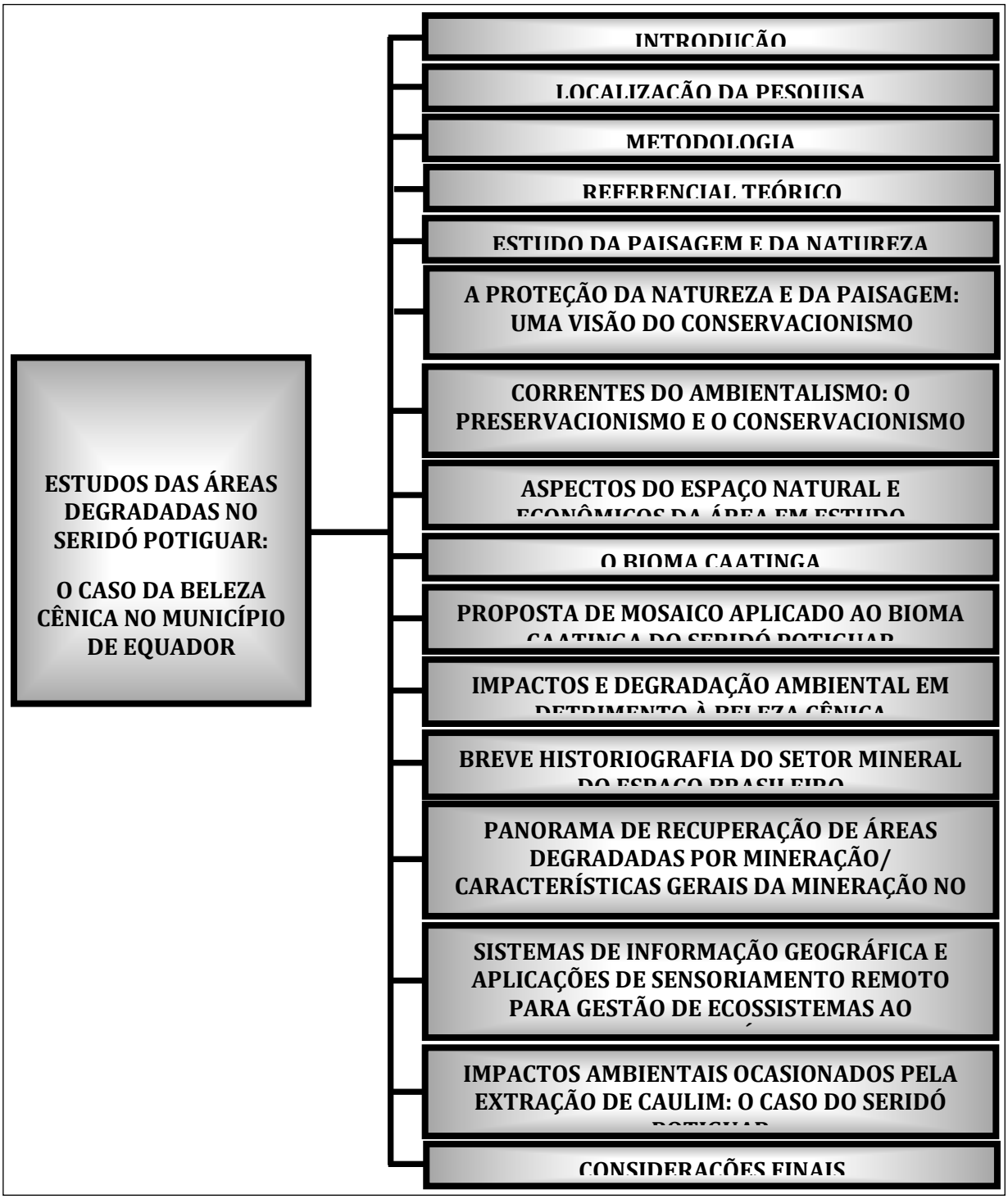

Figure 4–Organizationalstructureofthethesis.

Source: ownelaboration(2024)

CHAPTER IV

THEORETICAL FRAMEWORK

CONCEPT OF SCENARIO

The scenario is usually defined as the visual experience of a place when all its components are apparent. Scenic elements generally result from the abundance of natural resources. The word “scenic” is associated with a charming natural setting, where attractive views can be experienced. The enumeration of scenic elements helps to specify which parts constitute the unique characteristics that differentiate one place from another.
An assessment of the landscape implies how cultural values and psychological responses can be documented and analyzed to inform decisions about the management of people and usage patterns. The physical appearance of a place is the result of natural and cultural influences, although in varying degrees. Biological elements, such as land, water and vegetation, contribute significantly to this scenario, while cultural aspects can be activities human activities that reflect positive characteristics in the landscape. Such cultural aspects include fences, historic buildings, farms or plantations, while natural processes such as fires, lava flow, erosion or stream deposition are considered dynamic and inevitable, which in turn continue to continuously change the landscape.
According to the definition of the Millennium Ecosystem Assessment (MEA–2005), services environmental services are services that include benefits obtained by people from ecosystems. The seservices involve the transfer of natural resources, energy and information, as well as human capital and production services that contribute to human well-being. On the other hand, environmental benefits can be divided into four categories: services of supply, regulatory services, support services and cultural services. However, it can be problematic to differentiate these categories because the processes that generate benefits environmental issues are generally interconnected. The stability of the ecosystem over time and of space is sustained by the intricate interaction of various processes. Changes in culture have profound effects on the activities developed and, therefore, influence the natural alteration of the landscape.

Physiological Benefitsof Contemplating Landscape Scenarios

The saying that appreciating nature is a great way to relieve stress and recover has been repeated by many people, although some studies have endorsed affirmatively this reality. Today, visual research on the relationship between man and nature seems to be a trend. In addition, there are numerous physiological parameters in internal experiments that can demonstrate the positive influence of the natural environment to human beings. A series of clinical studies has indicated that exposure to elements of nature, including flowers, green plants or wood materials, can have beneficial influences, as measured by brain tests. These results indicate that natural elements can be included in treatment methods and this will increase the effectiveness of preventive medicine, especially in “nature therapy”. Given that the first hominids merged millions of years ago, it is not surprising that humans have learned to adapt naturally to environments overtime. Consequently, the functioning and characteristics of the human body, including its organs, have changed to function inc onjunction with nature. Unfortunately, with the rapid industrialization and urbanization, our daily environments have undergone transformations drastic. On the other hand, when it comes to the human body, the urban environment is relatively new in terms of our evolutionary history; therefore, it may seem quite strange. Natural therapy has emerged as an alternative to combat stress and develop well-being. Natural therapy is based on the idea that the body has balance mechanisms and healing, which can be encouraged by natural practices and resources. Its approaches move away, covering the techniques of the millennium with contemporary innovations inspired by nature. This technique involves stimulating a self-regulated state of relaxation, characterized by a healthy immune system. The recent development in physiological measurement technology offered scientific data on the positive effects of natural therapy on health. According to the research, immediate or indirect interaction with natural features, such as flowers, plants greens or wood materials, can lead to physiological calm and increased response immunological. In the field of sensory psychology, internal studies have been carried out with an emphasis on controlofstimuliandthephysicalenvironment. Sight, smellandtoucharethemostcommonlystudied studied in this context. The introduction of physiological indicators allowed the evaluation ofbody's response systems, such as brain

activity, the autonomic nervous system and the activity of the endocrine glands. This data is fundamental to understanding the physiological effects of exposure to nature, as well as to contrast the results obtained in natural conditions with those produced in controlled experiments conducted in door environments. One area of investigation that has been supported by studies involves the concept of relaxing in natural places like forests and meadows. According to investigations, our system responds well to these environments based on physiology. Thus, with the backing scientific of these assumptions, another notable approach that has also been investigated is therapy forest or shinrin-yoku.

Brain imaging studies have also shown that just observing a scene of forest stimulates the activity of the brain and the autonomic nervous system. The individuals were exposed to urban and forest landscapes for 90 seconds through a window while their cerebral concentrations of oxy-Hb were monitored. The findings suggested that there was a visible decrease in cerebral oxygenation after exposure to the forest scene. It is found that individuals who appreciate natural landscapes have advantages of physiological nature – including relaxation and improvement of the immune system. Therapy natural is a recognized method of promoting well-being and reducing stress levels. Some studies support the idea that exposure to nature has positive health effects, mainly with regard to the visual. A study by Kabuto tested the impact of physiological relaxation based on personal preference for natural scenes. The participants were twelve adult men who watched a self-selected video showing the sea or a forest while their physiological reactions were recorded. Based on preference for the sea or the forest, participants were separated into two groups; subsequently, physiological changes were measured and compared. A average heart rate for watching a sea video was higher than that recorded during the forest video experience. The degree of relaxation depends on how the arrangement is made physical of the vegetation in the forests. To examine this,180 university students participated of a visual experiment. A series of photographs were taken depicting various locations with different levels of vegetation cover. To find out the level of relaxation, participants watched a presentation of slides and their brain activity was recorded using an electroencephalogram. In these tests, it was found that those who were on the edge of the forest were more relaxed than those who was in the woods. Another experiment involving four teen children riding bicycles while watching videos

about the forest or a blank screen involved measuring changes in blood pressure and heart rate, observing them with researchers; consequently, systolic blood pressure decreased markedly in the group involved in outdoor activities compared to the control group. With regard to natural environments, numerous investigations have established the their therapeutic benefits, resulting in reduced stress levels. Furthermore, the observation of green flora is a primary instrument for shaping the state of human health, as it contributes to the stability of the brain and nervous system. A study found that observing live plants can decrease the intensity of the tab rain waves recorded in the frontal regions, leading to an improvement in students' concentration. An investigation was carried out by Chinese students on the repercussions of looking fixedly at a bamboo plant. There were two groups: one group looked at a vase of bamboo, while another group looked at an empty vase. Based on the results, those who saw the bamboo experienced a decrease in blood pressure and an increase in brain waves, which implied that they had relaxed biologically. In addition, some other studies have focused on how looking at plants as if they were leaves affect sour prefrontal cortex. In the course of the experiment, the subjects were exposed to two types of containers; those containing green leaves and others without leaves. A significant decline in levels of oxy-Hb in the prefrontal areas indicated physiological relaxation after viewing plants inside containers that mimicked natural environments. In a separate investigation, it was revealed that looking at roses has an impact on brain activity. To conclude, it was proven that fresh roses reduce oxy-Hb levels and there for provoke a state of relaxation by affecting the activity of the prefrontal cortex. An additional study with office workers found that roses, when observed carefully, also induce physiological relaxation in that specific group.

SCENIC BEAUTY

Concept of Scenic Beauty

The notion of “natural area of great scenic beauty” can be interpreted in various ways, ranging from places of extraordinary beauty, or end owed with a particular beauty, or even of landscape value, or finally considered universally highly appreciated from an

aesthetic point of view. Some researchers consider the analysis of the landscape in areas identified as scenic and suggest objective methods for evaluating this criterion subjective. Danieland Boster(1976) proposed a method for evaluating scenic beauty through landscape aesthetics. It was Elsner and Smardon (1979) who built a model for estimate the scenic beauty of forest landscapes perceived by people. With that they adopted the contingency method to assess the beauty of forests and fields. One approach was to consider the scenic beauty of an environment in terms of psychophysics. This helped to understand more about the natural environments that please human eyes and minds. Kalidindi et al. (1996), however, developed a computerized database where different methods were applied to estimate scenic beauty. Meitner and Daniel (1997) strived todiscover the possibilities of geographic information systems and create a model that helped to assess the beauty of natural landscapes. According to Muñoz-Pedreros and Larraín (2002), aesthetic value is one of the main components that contribute to the appreciation of the world natural, also enhancing other factors; therefore, they suggested the use of Geographic Information System (GIS) technologies to monitor environmental quality with a focus on scenic beauty. Implementations of contingency approach eosin the evaluation of landscape were implemented, where the main criterion for evaluating the environment is the beautiful views. Scenically significant landscapes do not simply benefit the individual who experiences them. They represent an important contribution to the overall attractiveness of an area and, as such, may be associated with extended economic benefits for a region (ZUB Eetal. , 1980). What is the origin of the expression scenic beauty? What is its meaning? What importance does scenic beauty has for the landscape? Ferreira (2009) has some concepts about the term beauty: Fromvulgar Latin bellitia. Feminine noun.1. Quality of beautiful. 2. Beautiful person. 3. Beautiful, very pleasant, or very tasty thing. 4. Particle Physics. Quantum number introduced to characterize properties of certain types of particles that contain at least one bottom. [By convention, bottom has beauty-1. Translation, inthissense, from English: beauty].

According to Auleteand Valente(2011), there are also the following denominations:

1. Quality of what is beautiful, of what is pleasing to the senses; 2. Aesthetic concept that is attributed to harmony of proportions, perfection of forms. 3. That which is beautiful, or that arouses admiration for its quality, for pleasing. 4. What arouses admiration (in

productions of intelligence). 5. As slang: used to express agreement or agreement with what is said or proposed by the interlocutor or to ask for agreement or agreement of the latter for something that was said. 6. As slang: used as a greeting or greeting.

The term (beauty) scenic is the feminine of scenic. According to Ferreira (2009), Auleteand Valente (2011), scenic, in Greekskenikó sand from Latinscenicu, is an adjective relative to the scene.

Accordingto Ferreira (2009), scene, in Greekskené; from Latinscena, isafemininenounand means: 1. Inancient Greekand Romantheaters, thecoveredperformancespace, located in the background, behind the proscenium. 2. The stage. 3. On stages, the main space of representation. 4. Scenery. 5. The theatrical art; the art of spectacle; the drama. 6. Any marking or dialogue of the actors. 7. Each of the units of action of a play, whose is done according to the entrances or exits of the actors; Frenchscene. 8. Each division of the situations or events in the course of the evolution of the plot of a play, film, soap opera, novel, etc.; episode. 9. Part of a film that covers several shots focusing a certain situation in which the same characters appear in the same environment. 10. Dramatic or comic event. 11. More or less censurable or scandalous. 12. Panorama, landscape.

The philosophers Plato, Aristotle, and Plotinus already dealt with beauty in Antiquity. For the Greeks, it is not possible to dissociate the ethical sense from the aesthetic sense. For Plato (428-348 BC), in his dialogues Hippias Major, in the Banquet (Symposium), in Philebus, in Phaedo, andin Phaedrus, the beauty is not based on images, but on abstract and eternal concepts and ideas (ideas of intelligible forms). Kirchof (2003, p.54) explains that, for Plato: [...]beauty, along with good and truth, is one of the eternal ideas that the soul knows before uniting with the body, therefore, when it is recognized in a material object, it points to the eternity of the spirit and not to the materialityof the object or to the sensations that are capable of causing on the subject. [...] beauty is coherently inserted into the general context of Plato's epistemology, according to which there are ideas, in which sensible objects participate. Our senses have the function of receiving (remembering), from the qualities of objects, the ideas, among which beauty is defined. Beauty takes the form of a concrete thing instead of an abstract notion, according to Aristotle's philosophic although. Beauty is the perception of pleasurable sensations or unpleasant sensations derived from visual and sound forms. It is defined as something

symmetrical, proportional, harmonious, and linked to divinity. It is one of the faculties of the soul that allows the human being to firmamental image of objects that reflect beauty. Beauty is present both in ethical and intellectual excellence, as in the harmony of the elements and in the realization. In Plotinus' opinion, beauty is a visible agent that stirs and motivates the soul. It is part of the ethical consonance and supernatural magnificence. The delight that the soul experiences for a work of art emanates from its ability to discern in it another human soul, given its susceptibility to superlative beauty. In this sense, Saint Augustine describes beauty as the delight that the soul experiences when it apprehends in an object certain ideas of order, proportion, and unity that belong both to the soul and to God. Saint Thomas Aquin assees beauty through the prism of integrity, proportionality, and clarity. For both philosophers, objects can lead to absolute beauty in God. Duringthe Renaissance, people began to see the world as a platform for human activities, rather than a manifestation of divine intentions. Renaissance individuals turned their attention to observing, researching, and representing the what nature had to offer, including its resources. It is characterized by scientific scientific achievements, technological progress, and the height of humanism. The notion of beauty ceases to be absolute and becomes dependent on the perception and self of the individual. According to Immanuel Kant, in the modern era, beauty is a matter of the subject, while quality is in the object. Natural beauty and artistic beauty were only marked at this time, but only in the 20 th century did artistic beauty become a sign of freedom and creativity in art. Aulete and Valente (2011) state that “scene” can be taken as equivalent to scenery, landscape and panorama. The richness of the scenic beauty of the environment can not be reduced to its role as a setting for representations. Thus, it is worth exploring when and why the interest in apprehending and defining the concept of beauty with its characteristics a rose–these questions were examined by many philosophers who presented diverse interpretations and meanings. In Antiquity, the philosophers Plato, Aristotle and Plotinus discussed beauty. For the Greeks, it was not possible to separate the ethical aspect from the aesthetic aspect. According to Aristotle (384– 322 BC), the beautiful ceases to be something abstract and becomes something concrete, with the perception of the beautiful a feeling of pleasure or displeasure caused by certain visual and auditory representations.

Table 1 presents a synthesis of the concepts of beautiful, sublime and picturesque from different philosophers in different periods.

FILÓSOFO	CONCEITO
Platão	Obelo(obemeaverdade)sãoideiasabstrataseeternasqueaalmaconheceantesdeseunir aocorpo,logo,quandoéreconhecido emumobjeto,apontaparaaeternidadedoespíritoenãoparaasuamaterialidadeouparaassensações quesão capazesdecausar.
Aristóteles	O belo é concreto e a sua percepção é uma sensação de prazer ou desprazer causada por certasrepresentações(definidaspelaordem,simetria,proporcionalidadeecomposição),geradasp elaaudiçãoepelavisão.
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WillianGilpin	Opitoresco éumtipo debelezaqueéagradávelemumaimagem.
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Table 1–Synthesis of the concept of beautiful, sublime and picturesque.
Source: Vieira(2014, p.43).

Philosophy answered questions about the meaning of the beautiful, beauty and aesthetics until the 19 th century. However, questions about the origin, importance and interest of human society in contemplating and protecting the beauty of a landscape were only answered in the 20 th century. At the end of the 18 th century, Caspar David Friedrich

stood out a sapid nearing aesthetic representation in the artistic movement of Romanticism. He believed that art should bring human beings closer to nature, and his landscape paintings reflect this. Friedrich's works are characterized by being empty of people or sparsely populated, as he portrays a space in nature that seems to have a meaning that human society lacks. For example, in "The Wanderer above the Sea of Fog", the viewer is represented from behind, placing himself before nature and, by observing it, unites with it in aesthetic contemplation, a scan be seen in Figure 5, below.

Figure 5 – Painting “The Wanderer above the Mists”. Source: Friedrich (1817-1818).

Thei dea of beauty was applied to gardens in Europe, while the idea of grandeur was associated with the manifestations of nature and the idea of picturesque refer red to nature portrayed in paintings. The influence of the picturesque has been present from the 18 th

century to the present day. The idea of exploring the natural world is still promoted through brochures, calendars and postcards sold in souvenir shops and travel agencies. The difference between territory and landscape is suggested in Figure 6, where the territory is the result of research and information, while the landscape is perceived according to culture.

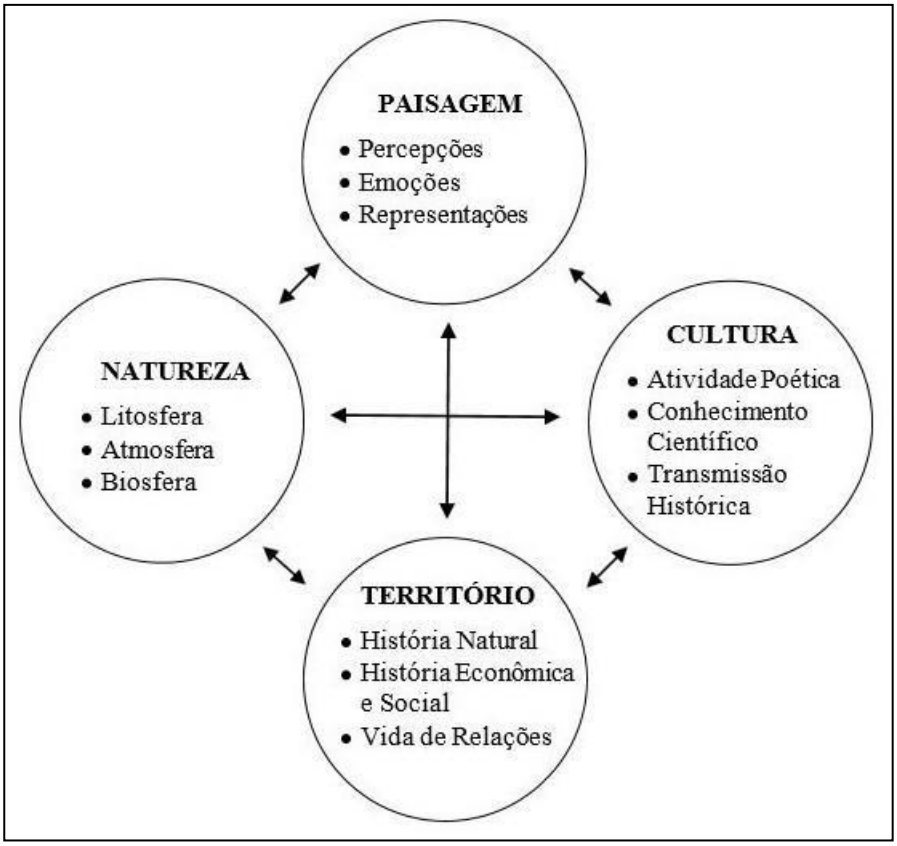

Figure 6–The relationships between territory and landscape as projections of the relationships between culture and nature. Source: Turri (199 S 8 Ea Rp RuÃd O,2011).

The sensation of scenic beauty, as an ecosystem service, is linked to the conservation and valorization of natural and cultural heritage such as forests and biodiversity, which are often ignored. Positive consequences would include the development of a sense of value in relation to rich natural and cultural landscapes. Similarly, strategies such as landscape branding contribute to the preservation of biodiversity, the restoration of ecosystems and ensure that rural communities also benefit. Beauty can be appreciated from a different

perspective, being natural landscapes. The beauty of nature is determined by how the elements are organized or fit into a single scene to form something that has characteristics of harmony. For this reason, it is important to see landscapes as an integral part of our world with all its senses – physical, mental and psychological. This means we must understand perception as the act of seeing the outside world using past experiences and data collected through the senses. The appreciation of natural beauty is an expression of respect for and conservation of natural and cultural heritage, including forests and diversity biological, which often goes unnoticed. The most common result of recognition of this contribution is the overall value that people have in natural landscapes, because it helps to conserve biodiversity, ecosystem recovery efforts and to create programs that contribute to rural community development strategies based on landscape. A view on aesthetics is related to the contemplation of natural landscapes. A perception of nature as beautiful depends on the harmony with which the elements of a scene combine or integrate into that scenario. Given the need to appreciate landscapes as an extension of our sensory world, it is essential that they include the psychophysical and cognitive aspects. It follows that perception can be seen as the process of interpreting the outside world through prior knowledge acquired and information received through the sense organs. Georg Simmel, in his essay “Philosophie der Landschaft” (1912), deals with the landscape as the subjective construction of human experience. For him, the landscape is not a simple set of natural elements, but a unit that observes the observer, the result of mental and emotional synthesis. Simmel says that the landscape appears when a individual organizes fragments of nature into a meaningful totality, under the influence of cultural values and personal experiences. He distinguishes a landscape from a natural environment simple, emphasizing the role of aesthetics and subjectivity in its perception. Therefore, the landscape does not exist objectively, but as a creation of a human aspect. The Scenic Beauty of the Stone Fences of the Municipality of Equador/RN Research on geodiversity and geological heritage is important to protect the natural’s paces for future generations. In Seridó Potiguar, the stone fences are vestiges of the use of geological resources by local residents throughout the socioeconomic cycles of the region. In the municipality, along Highway 086 towards Equador-Parelhas, there is a remnant of scenic

beauty of this testimony of stone fence, built in the decade of forties, ass honing Photo 1, below.

Photo 1–Vestige of scenic beauty of stone fence construction. Source: Author's archive (2023).

The ancient practice of building stone fences is a tradition that reveals much about the communities that adopted it. These palisades, like “beehive walls,” are common in cultures with plenty of stone available and appear for specific reasons. This form architectural can be found in areas as diverse as Palestine, the Iberian Peninsula and the French and Italian Alps, where it was used to protect beehives from predators. There are also reports of this type off enceinte Florence in France. There are reports of this type of construction in biblical Palestine, as were ad Proverbs 24:31:“And behold, it was all full of thorns, [and] its surface covered with nettles; and its stone fence was torn down”. In Brazil, there is news of the custom of this type of construction in Rio Grande do Sul, in Pernambuco, in Piauí and in Rio Grande do Norte. This habit, at least in Rio Grande do Sul, may be associated with population growth and increased herds, when there was “[…] the need to limits pace through the demarcation and appropriation of land and its division into areas of culture and pasture” (EMBRAPA, 2005). A completely different purpose different from those more common in Europe, whose primacy was the defense of beehives or villages against predators, or enemies. These stone fences are considered important cultural and social landmarks, as representing an example of sustainable use of natural resources found biodiversity local. However, in some sections to our sadness, abandonment causes this record historical succumbs over time.

Geological heritage can be defined as the set of geological environments characterized in an area, region or country. All of the geo environmental set are part of this set, elements that constitute geo diversity and that have exponential value, encompassing, the heritages: paleontological, mineralogical, geomorphological, petrological, hydrogeological, among others (BRILHA, 2005). According to the author, geodiversity corresponds to variety of a biotic environments, phenomena, processes and elements of the Earth, in the present and in the geological past. According to the author, the interaction of the sea biotic elements, with each other and with the living beings, is what enables the emergence of the most varied landscapes and sets geo-environmental that support the development of biodiversity. When classifying natural landscapes and human creations according to their functions social, we can identify them as heritage, something that belongs to man and is located in territory occupied or controlled by a specific group. This appropriation process stems from historical events related to the occupation and use of these natural elements and human works. To better understand heritage, we can divide it into two major categories: natural heritage and cultural heritage. Overtime, people have given more importance to cultural aspects than to natural ones, which is a mistake. Natural heritage should deserve equal attention in investigation, conservation and valorization activities because it also does part of the heritage of society and deserves protection and valorization. An ancient practice in some parts of the world is the construction of stone walls, which have become a distinctive feature of rural landscapes in traditional areas. These walls symbolize the balanced and lasting coexistence of certain communities with the distinct geological diversity that constitutes the heritage of the subareas. Understanding how communities use geological and geographical heritage can help us better understand how they use these resources in their territories. In Seridó Potiguar is evident the connection between geological heritage and occupation, use and delimitation of the soil. The construction of stone fences highlights the importance of this relationship in the protection of heritage cultural. The construction of dry stone walls is an ancient and simple construction technique that uses stone without mortar. Ancient civilizations such as the Egyptians and the Incas left traces of these structures around the world. The stone palisade is an example of this type of construction that is still used today. The structures are built according to the conditions geological and environmental

conditions of the region, ensuring stability through the care of fitting each stone. Currently, there is a growing interest in these constructions around the world. The pressure of the stones on the top and the way they are interconnected ensures the stability of these structures. In recent times, interest in these structures has been growing in several regions of the world, especially in regions where they are very old, due to the fact that these are considered important records of human history, in addition to habitats of various plant and animal species currently (MANENTI,2014). Stone fences are common in rural landscapes on several continents, including Europe, Asia, Africa, the Middle East, Oceania, the Americas, andespeciallythe United Kingdom. They are found in approximately 35 countries and are thought to unify the character landscape of their regions. Stone fences have been more studied on the European continent, mainly on the islands of Great Britain and Ireland, where there has been great concentration and effort preserve and disseminate the construction technique. In Scotland, for example, the fences of stone date back to the Neolithic period. It is in Scotland where most of the fences of stone from this portion of Europe are found and where the construction practices are best preserved in masonry with dry stones. In Ireland, stone fences built by prehistoric farmers dating back 3000 to 4000 years ago have been found (MACWEENEY; CONNIFF, 1986). However, despite the construction of this type of fence having been occurring since pre- historic times, the large-scale construction of stone fences only begins to occur with the boom of wool, in the mid-sixteenth century, to accommodate the increase and improvement of herds sheep (VINES, 1990). In Brazil, stone fences are more common in the Northeast and South regions. In the South, mainly in Rio Grande do Sul, stone fences appeared after the Land Code of 1850 to divide land and separate crops from live stock. The origins of this tradition in the region are not are clear, but it represents the use of natural resources for cultural production. In the Northeast, stone fences have diverse origins, with hypotheses based on oral accounts. In Rio Grande do Norte, the influence of Moor is hand Jewish culture stands out, which may explain the tradition of stone fences in Seridó Potiguar. These fences stand out in the rural landscape of the region, symbolizing the relationship between occupation and natural resources in Rio Great of the North. For different types of stone fences, it is not possible to establish a system of global classification due to differences in techniques and styles used in different parts of

the world. However, there are several typological systems widely cited in the literature international, each based on specific classification criteria. Saron (2007) classified stone fences found in Estonia based on the type of rock used in its construction. He identified three basic types: granite fences, fences of limestone and mixed stone fences made of granite and limestone. This classification reflects the man's relationship with local geological diversity. However, there are other types of rock in different parts of the world, such as the gin issued in the construction of stone fences in Seridó Potiguar. Reed (2002) classified stone fences according to their function in rural landscapes. He identified two main types: free walls, used to demarcate boundaries of properties, and retaining walls, used for protection against erosion and landslides of land. With the arrival of the Portuguese in Brazil, many aspects of Iberian culture were incorporated into the lands of the new world, in a process of mixing that involved the indigenous and the Africans. The colonizers brought elements of Moor are culture, which continue present in Brazil today. Stone fences, possibly a Moor is technique, were introduced in Brazil and a remain found in the Northeast and South of the country. In the South, the fences arose to demarcate land after the Land Law of 1850, while in the Northeast, the origins of stone fences are linked to cultural traditions such as Moor is hand Jewish. In the Seridó Potiguar, stone fences are striking symbols of the region, showing the relationship between occupation and geological resources. Due to the different technique sand styles used in different parts of the world, it is not possible to create a universal classification system for the different types of stone fences. However, there are several classification systems widely cited in the literature international, each based on specific classification criteria. Saron (2007), when explaining the occurrence of dry stone structures found in the rural landscapes of Estonia, classifies the musing the litho logy of the rocks as a basic criterion used in construction. According to the author, there are three basic types of stone fences: stone fences granite, limestone stone fences and mixed stone fences, composed of intercalation of granite and limestone. This classification, as can be seen, reflects well the relationship of the human being with the local geodiversity that he has at his disposal. However, although rocks are found in many parts of the world, there are many other types of rocks on Earth besides those mentioned by the author. For example, in the Seridó Potiguar region, gne is was widely used for the construction of stone fences.

The stone fence of Seridó Potiguar was probably built by Jews who arrived in the region in colonial times. These structures served to divide properties rural areas and show the Jewish presence in the region. The Jews chose the Northeast of Brazil to live because the conditions were similar to those of their eastern regions of origin. Many of these Jews were Marranos who converted to Catholicism and arrived in the Northeast of Brazil from 1654 to escape persecution by the Portuguese government. The word “Seridó” is of Hebrew origin and means “survivor” or “he who escaped”, which may be a reference to the fact that the area is a refuge for the Jewish people. A Jewish influence on stone fence construction techniques, as well as the availability of raw materials, are the likely explanations for the origin of these structures in the region. In the however, there is also a Moorish influence, as the Marrano Jews are a mixture of pure Jews and Moors. In addition to the division of properties, the stone fences of Seridó Potiguar are associated to the economic circulation of cattle and cotton, telling the story of the rural occupation of the region. They served to separate cotton plantations from cattle pastures, allowing the simultaneous development of the two main economic activities in the region. Currently, the maintenance practices of the old stone fences in the Seridó Region are threatened by abandonment and vandalism. Unlike other parts of the world, such as the United Kingdom and Australia, where stone fences are being replaced by wire barbed, few traditional builders remain active in the transmission of knowledge. In some rural areas, old stone fences can be seen coexisting with wooden and barbed wire structures, having a negative impact on the natural beauty of the area. In addition, a new type of concrete fence is emerging and becoming popular in the area.

CHAPTER V

STUDY OF LANDSCAPE AND NATURE

Only after the disturbance of the very concept of landscape did it become an idea familiar. The idea of landscape was modeled from people's observation of nature and through reflections on the meaning of what the landscape would be, being contained in different civilizations, intending to be artistic or scientific. Cave paintings were the first representations of landscapes as found in Lascaux in France and in northern Spain, which engendered an artistic phenomenon called “cave painting”. The well-known image we have of the landscape was shaped by the influx of philosophy, aesthetics, politics, religion and science in different intensities and moments of time in which the understanding of the landscape was formed. In addition to this, from the nature profile of each area, the interaction between men and nature varies. Depending on the culture and domain scientific, the idea of the landscape is also proposed under different territories. Despite the diversity, there are universal measures to determine a landscape.

LANDSCAPE PERCEPTION FROM ANTIQUITY TO THE 20 TH CENTURY

Egypt, in the period of the Fourth Dynasty, 2500 BC, witnessed the growth of walled neighborhoods adorned with gardens, wells, terraces, pavilions and stables. The transition from the best manure an center surrounded by large green spaces occurred at that time. Taking care of orchards and parks, the Mesopotamian people venerated their landscape; perceived the rivers flowing as a source of sustenance; learned weather forecasts and seasons by observingthe starry sky; and recognized legal processes related to agricultural development with subtlety. A garden in a fortified city could be used as a refuge against threats that could come from outside. The perception of the landscape in earlier times was more a matter of being careful and safe, as they did not have a good understanding of reality. However, the current understanding of landscapes is based on perceived realism and the economic value attributed to them. In the past, landscape features were critically selected and transferred to safer places, where they were even considered dangerous. But

today, the selection of landscape features that attract attention are influenced by trends and values related to modern security. Hunting grounds and oases, along with the fertile water source system of the valley of the Tigris and Euphrates rivers, were also significant components of the natural landscape. A tradition was equally popular in the Spanish Moor is gardens of Granada, Córdoba and Toledo. When developing a landscape project, it was necessary to keep in mind the utility and beauty, as they needed to serve as functional elements within a rather difficult environmental context. The city of Rome is full of parks with beautiful architectural structures, such as pergolas, columns and porticos. In the Middle Ages, gardens were initially planned as fortifications, but gradually became available to all visitors unknown.

The appreciation of nature in art was limited during much of the history of Westerncivilization. However, in Chineseand Japaneseartistictraditions, natureis portrayed as a vital force with which people are intimately connected. The forests lush and rich biodiversity found throughout the landscape of China have long been celebrated for its aesthetic beauty and is deeply rooted in thought and Chinese philosophy. An example of the relationship between man and the environment can be seen in the gardens of the imperial palace, in the artificial lakes, in the bird aviaries and in other elements. Wang Wei, a landscape painter of the Tang Dynasty, described the teagardens as representations of a celestial world; majestic mountains and running water were notable features. The Japanese gardens of private residences also communicate nature from the core, as they are aimed at an individual seeking to find peace and spiritual tranquility.

In the regions of the Far East, with a strong influence of painting and poetry in the gardens, they reflect not only the natural environment in its objectivity, but also its subjectivity as an emotional sphere. In Europe, the concept of landscape evolved during migrations, colonization, the emergence of newspapers and the development of photography. In France, since the Renaissance, the expression “landscape” has been understood as a region or scenario shaped by natural causes. Although the medieval gardens of France exhibited nature as a fixed system through symmetry and axial arrangements, they lacked elements of “wilderness”. The art of the garden has often been seen as an intervention of man in the nature, thus becoming landscape art; representing landscapes, drawing maps and considering the broader human context. The

Mediterranean, the Middle East and the Far East strongly influenced people's perception of the landscape. The concept of landscape in Brazil is significantly influenced by its connection with the Old and New World, its interconnected histories, shared heritage and cultures. Geographers from France and Germany have contributed significantly to the identification and reading of landscapes Brazilian.

LANDSCAPE IN ALEXANDER VON HUMBOLDT

It was July 16,1799 when Alexander von Humboldt arrived in the city of Cumaná (now in Venezuela), coming from Spain by sea on the ship Pizarro, which crossed the Ocean Atlantic in forty-one days. During this trip, he was not alone, as there was another Humboldt's friend, the botanist Aimé Bonpland, who accompanied him. In collaboration, they examined Latin America for a long period of five years, analyzing its patterns climatic and geophysical, and gathered a wide range of native flora and fauna samples.

Born into a wealthy family in Berlin, Germany, Humboldt discovered the mountains European when he was still a boy. Due to his privileged education, he was able to leave the confines of Europe and deepen his knowledge in the field of scientific research. Although Humboldt's expedition to Latin America was not the first to describe the botanical and zoological wealth of the region (as José Celestino Mutis had already accumulated a vast herbarium), his expedition was unique because of the comparison she made between American and European. Such intercontinental comparisons were extremely important in biogeography, a subject developed by Humboldt– one of his favorites; it is described in a later book, “Essay on the Geography and Humidity of Plants”, which is now considered the first scientific treatise on ecology.

Later, he built links between these distributions and other mountainous regions around the world, underlining a universal connection shared by the biotic and abiotic. This association of multiple components in nature challenged the thinking scientific prevailing at the time, which was based primarily on individual organisms following Linnaeus' ideas. In terms of his concept, Humboldt's contribution can be seen as a precursor to Darwin's theories of evolution, which exposed the system of life not from the point of view of simple connections, but as a global unit, represented by an extensive network and

interconnected. Humboldt called this complex fabric Naturgemälde, where all natural elements are interconnected. Thus, when describing the vegetative zones of Mount Chimborazo, in Ecuador, he went beyond the relationships of altitude, temperature and humidity, comparing them with other mountain ranges on the planet to prove the biotic link- a biotic globally. Figure 7 represents Humboldt'sviewof Mount Chimborazo,
in Ecuador.

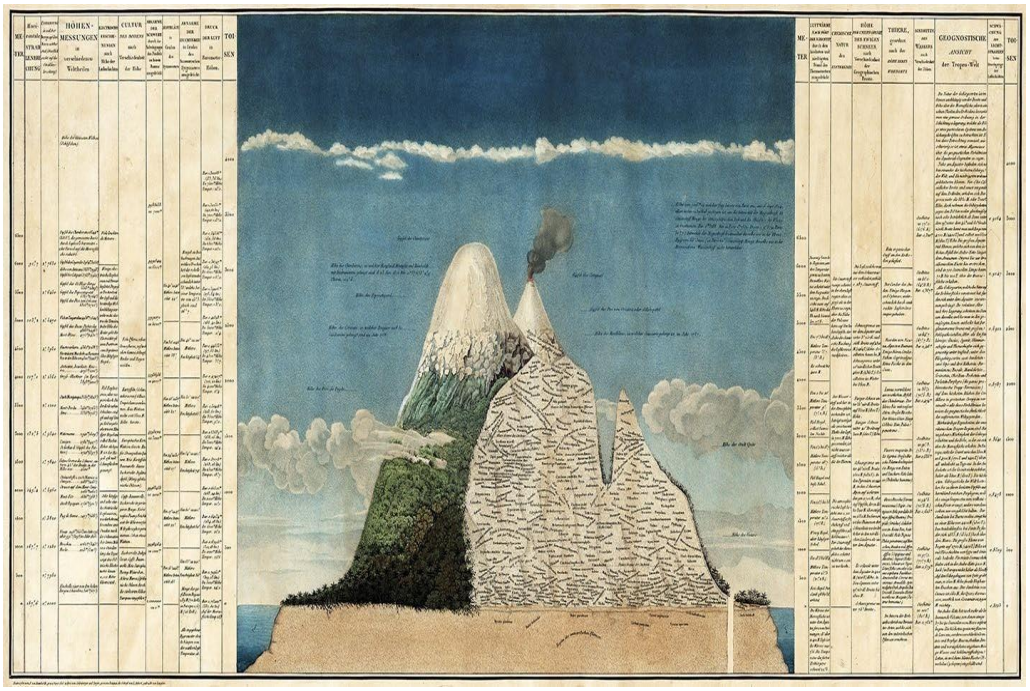

Figure 7–Humboldt's View of Mount Chimborazo, Ecuador.
Source: First printed in his book, Essay on the Geography of Plants, this image is the first representation of Humboldt, idea of an interconnected web of life, or Naturgemälde, which translates roughly as “nature painting”. Credit: Science History Images/Alamy Stock Photo.

In light of Humboldt's observations, the settlers who removed forests for activities agricultural and the textile industries in Europe and America are the two main factors that could not be reversed and would have major impacts on the landscape. This will lead to the destruction of the natural vegetation cover, leaving it barren and unproductive.

Another factor that influenced Humboldt's interest in Latin America is its volcanic mountainous region, where he found more than enough material to fuel his passion for the idea of activity volcanic. Although Europe had few known examples of mount a information volcanic, they explored some of them during their brief visit to Latin America. Working with altimeter, barometer, magnetic compass and geographic data readings, the researchers explored various regions of the Andes Mountains. Using the isometrics, Humboldt calculated that the Earth's magnetic field was centered about 800 kilometers south of the Equator. In the future, he played an important role in the development of the global geomagnetic network that evolved into modern scientific collaboration experiments international based on landmark dates, now active through out the Earth. The contributions and Humboldt's concepts are still very visible in science today. From 1808 to 1812, four years after his trip through America, Humboldt introduced a masterpiece called “Images of Nature” (Ansichten der Natur and Tableaux de la Nature) in Germany and France. Thereports, observations and materials accumulated by Humboldt and Aimé Bonpland during the trip through the American continent were analyzed and edited in a vast informative publication. This American work was published by the scientific society as a set of 30 volumes called “Voyageaux Régions Équinoxialesau Nouveau Continentfaiten 1799,1800,1801,1802,1803 et 1804”, with financial assistance from the King of France, having taken more than twenty years to be completed. The collection “Images of Nature” presents diverse natural landscapes on all continents, offering a aesthetic and scientific glimpse of the natural world of the 19 th century. The essence that unites the images tems from their in the rent unity which, despite the varied points of view and presentation styles, perpetuates a sense of cohesion through the emphasis on physical attributes of nature–the descriptive quality creates vivid images in thought sand in someone's imagination. It is this simplicity and also this descriptive language that avoids harming the direct experiences associated with the appreciation of the natural environment by viewers. In his theory, Humboldt argued that the reader would be able to perceive what he saw. Thus, the landscape in Humboldt represents an activity of an endlessly inquisitive mind that tries to understand the new phenomenon and, consequently, become part of it. The paintings are always connected

with the reality of physical space. Figure 8, below, represents a drawing of the Tapiaplateau in the Andes.

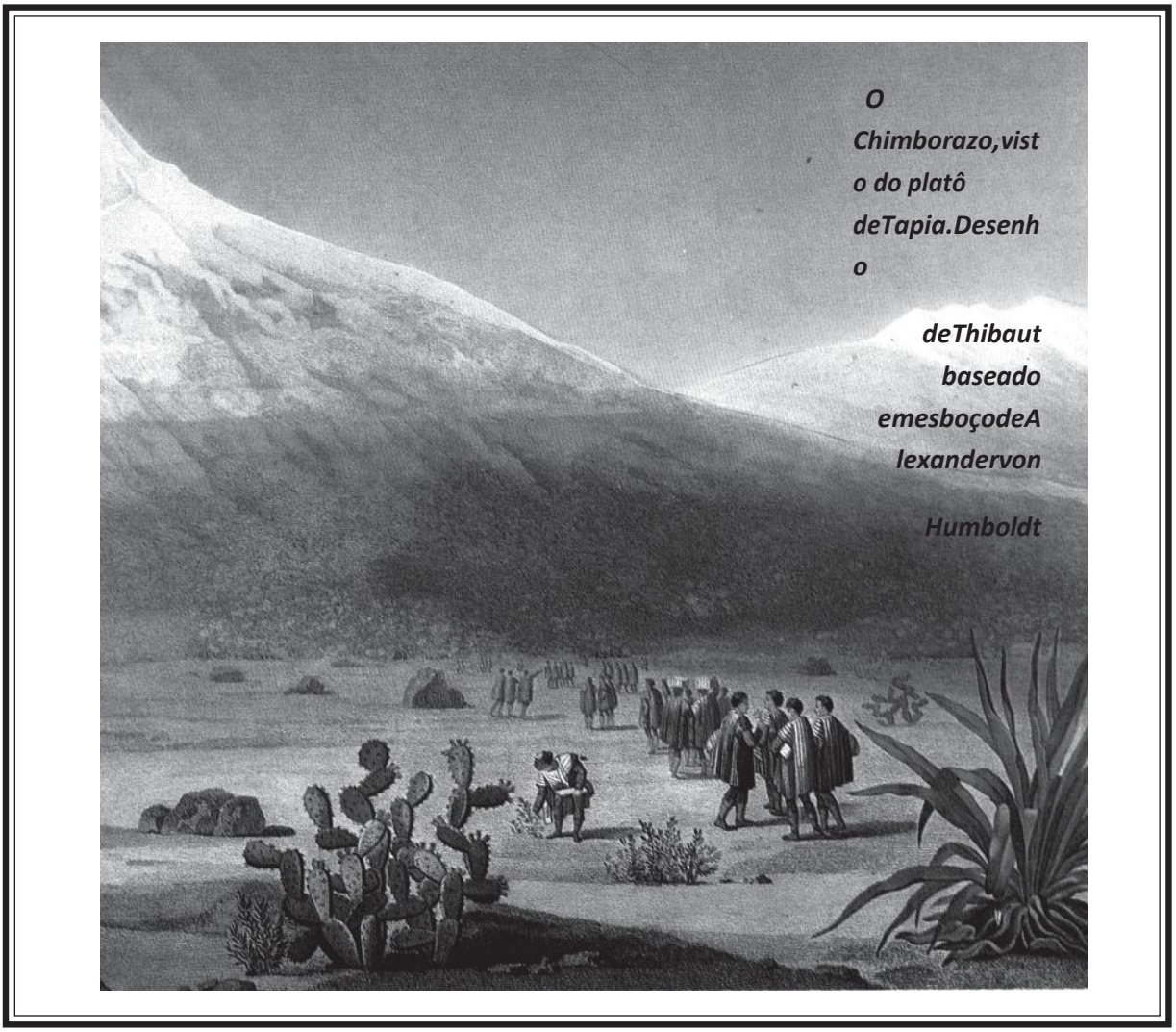

Figure 8 – First landscape sketch. Alexander von Humboldt (1808), “Vorrede zur ersten Ausgabe”.
Source: Ansichtender Natur, Greno Franz, Nördlingen(1986, p.9).

The gaze of someone looking at an object can be more than just a source of poetry; it is also indicative that they are trying to see the story from its depths. Even if it means moving away from personal experiences and diving into a scenario cultural that is still being formed. When contemplating a natural landscape, one can perceive how these

scenes have their own stories created through the relationship between perception, understanding and representation; in essence, they refer to the infinite source that gave them meaning. The connection between a diffuse awareness and the ecstatic understanding of natural forms that emerges during landscape observation can be described as magical in this context. In this way, moving forward, the viewer advances through the visual field with mountains that appear ahead and ad is tenth horizon at stretches into the background and continues his gaze even without no particular purpose; finds pleasure in exploring and investigating possibilities unknown in moments when reflecting on themselves. Through its own fixity or dynamism, vision is an arbiter of thoughts intricate, not only producing a concrete reality, but also a compelling content incorporated into science. An ongoing conversation characterizes the relationship between vision and mind. They are not entities completely separate, but rather two mutually influenced parts in alignment. A visual perception of the environment can also be used to amplify the state of mind to a more thoughtful creative thought process, as its development occurs through the reception of stimuli from the sense organs.

This suggests a broader form of perception – an attentive gaze turned to sounds, tastes and smells, along with the ability to reflect and contemplate the dynamic forces of nature. As Humboldt (1808) argued, it was past eleven o'clock when a noise began in the immediate forest such that it was necessary to absolutely give up sleeping for the rest of the night. All the undergrowth resounded with wild cries. [...] They were the guttural and monotonous howls of the howler monkeys; the plaintive and flute-like voice of the tities, and the snores of the sleepy monkey (Nyctipithecus trivirgatus), whose description I gave in the first place; the intermittent cries of the great tiger of America, the cougar or lion without a mane, the peccary, the sloth and a swarm of parakeets, those of piraguas (Ortalida) and other gallinaceous birds. [...] Everything announces a world of organic forces in motion. In each thicket, in the cracked bark of the trees and in the earth that the heminoptera dig, life stirs and makes itself heard, like one of the thousand voices that nature sends to the pious and sensitive soulofman(Op. cit., vol.2, pp.268 and 270).

Humboldt, who introduced the science of botanical geography (1769-1857), provided a new interpretation of the concept of landscape. In the 17 th and 18 th centuries, the landscape was mainly associated with painting. The portrayed landscapes became linked

to natural environments, but around 1800 it was not common to refer to these areas as “landscapes”. Humboldt approached vegetation artistically, considering that artists could suggest through their works an abstract unity underlying visible phenomena. Landscape art in nature has its roots in Humboldt's concept of understanding the ecosystem as a whole. It refers to its aesthetic ally pleasing aspect with associated meaning that includes all aspects of the natural environment. Accordingto Pedras (2000, p.99-101), Humboldt prescribed a detailed description of the landscape.

5.3 The Landscape as a Picture of Nature in Goethe

Surprisingly, Great Britain was one of the first industrialized nations to support preservationism. A book called “Man and the Natural World” by Keith Thomas, examines the transformations that the perception of nature has undergone overtime. The evolution of these changes was mainly caused by industrialization and urbanization, which resulted in enormous damage to nature. Historian George Macaulay traveled and described this change as an abrupt erosion of natural beauty, as it proved to be a vital part of the economic infrastructure; in a short period, more than 50% of natural areas would be lost (THOMAS, 1983). It is almost impossible today to believe that nothing would survive these transformations. The phrase is profound because it draws attention to two aspects of conservation efforts throughout time. The first deals with the appreciation of natural beauty and its protection for the well-being of humanity. The second deals with giving due respect to other forms of life, plants and landscapes, instead of unconsciously using them for personal gain. Another feature that can be mentioned concerns the origin of conservation methods and the creation of areas protected as a fundamental way of “preserving what has not yet been disturbed”. Great Britain followed suiting this regard, and such efforts include the creation of parks and reserves of hunting, while in the United States and other parts of the planet natural parks were created natural. Consequently, these natural sanctuaries are exempt from any interference human or destructive influences. The combination of a classical poet and an avid naturalist would be better to describe Goethe's scientific investigation, which was as profound as his literary production, although often underestimated. His willingness to unravel the secret of life

and its complex fabrications – the mysteries underlying cause and effect – forced him to formulate a conceptual model of how the laws of nature unfold and change over time.

Johann Wolfgang Goethe was known for his deep interest in the sciences natural, particularlybotany, geology, mineralogy, otology, anatomy, morphology, as well as physical phenomena such as optics, colors, magnetism, galvanic is man meteorology.

He also wrote works that were continuously revised over the years, works that oftenstandoutfortheircomplexityandoriginality; thatiswhymany scientists of the time considered them very difficult to be fully understood or recognized as valid scientific pieces (GONÇALVES, 2003).

Some authors consider that the roots of the movement for protected areas go back to antiquity. Colchester (2000) states that hunting reserves would appear in Assyria as early as 700 BC, and in India around 400 BC. In Europe, according to the author, the idea would be introduced in the 11 th century.

Critics of Goethe's work, especially his study of the metamorphosis of plants, dismissed it due to its basis in Platonic idealism and intellectual intuition as opposed to the empiricism of natural science; however, some admire his investigations from a different perspective. Some argue that the metaphysical abstraction inherent in Goethe's research, where observable phenomena are linked to idealized forms, represents his extraordinary creative talent. Furthermore, there is praise for his discoveries, emphasizing the importance of the similarities between leaves and reproductive structures. Another group claims that during an era when the techniques employed in pale boot any were in their initials tags, Goe the encouraged imaginative thinking by introducing a structure ecologically integrated to analyze nature. But some people disagreed with these ideas and considered the way he interpreted the process of plant metamorphosis as deeply mystical and rooted in a comprehensive cosmic system. Finally, Goethe's scientific production has been too lightly associated, often from an attitude of contempt, with a kind of magma in which the heritage of mysticism, alchemy, Platonicidealism, Neoplatonicpantheism, pre-Darwinian evolutionism and romantic Naturphilosophie (MECA,1997, p. 20) are confusedly mixed.

Although his scientific investigations and literary works are less known, Goethe's natural poetry and great interest in naturalism made him a true man of science. Driven by an

insatiable curiosity about the inexplicable wonders of life–the elusive force that determines the cause of the effect–he sought a way to theorize the processes through which the laws of nature worked and changed through temporal spaces.

During his life, Johann Wolfgang Goe the dedicated himself to the sciences, engaging in studies covering the areas of botany, geology, mineralogy, osteology, anatomy,

morphology and physics into pics as broad as optics and colors, magnetism, galvanism and meteorology. These works were meticulously reviewed by him throughout his life because they were often considered complex and original; therefore, many scientists of the time had difficulty understanding the more judging their scientific merit (GONÇALVES, 2003).

Although some of Goethe's works, such as the study of plant metamorphosis, have been rejected by critics as being based on Platonic idealism and intuition intellectual, and not on the empiricism of the natural sciences, there are also individuals who appreciate his investigations in a different way. Some argue that the abstract metaphysics found in Goethe's research, which links observed phenomena with hypothetical forms, is evidence of his extraordinary artistic talent. Another group praises his discoveries, emphasizing how significant the similarities are between the leaves and the arrangement of the reproductive parts. Last, there are also those who argue that, at a time when the techniques of paleobotany were still in the early stages of development, Goethe opened new horizons for ecological analysis through the presentation of integrative ecological paradigms. However, the metamorphosis of plants, as he saw it, was considered controversial by those who did not subscribe to his views, claiming that his interpretation of morphological changes in plants was heavily imbued with mystic is mend based on some global cosmic order. Some of the ideas about primary similarity, branching and unity of types sounded like Schelling or Plato.

I am not taking this wonderful trip for the purpose of deceiving myself, but rathertoknowmyselfbetterfromtheobjects Isee; inallhonesty, Isayto myself, therefore, that I understand little of art, of the work of painters. Thus, my attention and my observation can only turn to the practical side, to the object itself, in general, to the treatment that was given to it (GOETHE,1999, p.53-54).

Goethe had at his disposal rich source of knowledge in Nature, whose extent is due to observation, and through it he managed to perfect himself in many things. With the passage of time, having carried out these experiences quite frequently, he began toperceive the characteristics of each phenomenon, separating them from the existing reality and examining them more deeply. There was no need for any specific knowledge when he sought to reveal the nature of any natural event; it was enough that he felt attracted by the beauty that shone formatter by what was hidden behind the outer appearance. From the none, his goal became to transform information in to data and arrive at something general that could be adapted to any particular case.

This look, this observation, is not only aimed at the world of natural sciences; the artist himself must seek the singular, in order to, from it, advance towards what is not given by the immediate intuition of the object. It is in this apparent confusion of phenomena that the gaze is educated, it is from the perception of this that Goethe's morphological project seems to take shape [...] (GALÉ, 2009, p. 38).

The German writer Goethe, who was considered a polymath throughout his life, stated that art always arises from nature and that this influence can still be observed today. His interests were broad, including sciences and also arts, and he did not differentiate them, appreciating them equally. He tried to find the connection between himself and the world, trying to see things in terms of organic forms, such as the landscape, instead of the microcosm. It was through observation that these connections became visible, with the comparative methodology and the analogies playing an important role in discovering what connected things and, therefore, what constituted their order. Goethe believed that science was about discovering how things are organized. He felt that it was important to study the appearance and internal structure of natural events to understand the principles that govern them. For him, observation plays a vital role in the researcher's work, because it helps him to differentiate what is singular and what is common. For the researcher, nature does not appear as something detached, but rather as an extension of itself in the object of study exposing its true essence. These thinkers do not make a clear distinction between art and science. Art was held as something more than merely reflecting, but as an active creativity that involved the effort of philosophers and scientists to fully grasp their subjects. In this case, truth is a union of physics and philosophy under universality.

At the same time, reason a blemish as a different look for truth. Goethe once believed that the vision shared between artists and scientists was to reveal the sign of nature on a canvas. For Goethe, such a vision could have valued the mixture of science with the pleasure in someone's subjective experience.

It was during his trip through Italian territory that Goethe came across apeculiar similarity of Greek landscapes with Hackert's paintings. Recognized for his clear and meticulous approach, Hackert managed to portray nature so faithfully to its distinctivecharacteristics. Consequently, in collaboration with Hackert, Goethe learned to perceive small details and to understand the bigger picture, as well as to establish the harmony between the different natural elements, relating them not only to visions ancient, but also with people of antiquity. The art of painting is the analysis of enchanting phenomena that result from the combination perfect of form, color and light. A landscape painted on a canvas can be defined as a form of frozen nature and, in these works, the artist strives to find harmony and beauty.

[...] copying forms from nature, observing the color and incidence of light and organizing them in such a way as to produce the best effect on the observer, in a composition that requires the recognition of rules for transposing the elements found in nature into a pictorial language (MATTOS, 2008, p. 53).

Goethe's landscapes exhibit an elegant harmony and a reciprocity of parts that blend together to create a consummate whole. This is how the poet captures instants tiny of ever-changing colors when light turns into shadows. Furthermore in addition, the landscapes, in their numerous movements, expose the various patterns of nature, while the mediating element with art resides in the meaning of nature itself. The landscapes are not based on abstract mathematical concepts, but contain feelings and imagination. The realization of the existence of nature reinforces a feeling of unity and emphasizes the search for harmony between personal desires and objective realities, a search that the era of technology complicates. Goethe alludes to the famous thinker Alexander von Humboldt in his works.

The physical world is reflected in the deepest part of us, in all its living truth. Everything that gives a landscape its individual character – the outline of the mountains that delimit the horizon, the vaporous backgrounds, the darkness of the pine forests, the torrent that

escapes from the middle of the woods and falls with a crash between the suspended rocks–has always been in a mysterious relationship with the internal life of man (HUMBOLDT,1868 apud BESSE,2006, p.47).

In Goethe's natural science, which is read and studied by more than a generation of scientistswho, in turn, will be interested in the protection of Nature and in a view of the Earth seen from the universe, his landscape studies, including geomorphology, reflected the perception of the poet-scientist about his Germanic roots.

LANDSCAPE AND ART

The idea of landscape, as we know it, is rooted in the image and hasplayed an important role in its transformation over time. Throughout the centuries, the understanding of landscape has expanded in the visual arts, ceasing to denote only gardens or agricultural fields. The emergence of urban garden projects is a logical result of the development of architectural activities, when the landscape was born to exist as notion around the 15 th century, capturing ideas, thoughts, beliefs and emotions. In art, the adequate representation of the landscape only came to be seen as an independent the me and form narrative from the 17 th century on wards. During the 19 th century, arena of industrialization, expansion in to new territories and scientific developments in botany and geography helped to further broaden the notion of landscape. Around the turn of the 20 th century, the conservation movements emerged as a response to the drastic environmental devastation and the loss of rural landscapes. Currently, the landscape is considered an interdisciplinary field that brings to get her various levels of meaning, thus forming a community that is built through dialogue with its past; while representing ideas, emotions, experiences or even dreams and fears. Painting acts as an important means of communication of these human perspectives.

LANDSCAPE AS TEXT

One of the essential factors in the development of the concept of landscape is visual representation. For example, overtime, the meaning attributed to a landscape in the

pictorial arts has gone from a mere garden or agricultural land to something larger and deeper. Urban gardening projects arose naturally from works architectural, where the 15 th century was one of the first manifestations of landscapes as ideas that spring from human consciousness, such as thought, belief and emotion. In the 17 th century, the landscape began to emerge as an autonomous the me and as a artistic story in itself. Driven by industrialization and new discoveries, developments in botany and geography, the concept of landscape gained greater momentum during the 19 th century. The beginning of the 20 th century was marked by environmental conservation movements that arose in response to environmental degradation and the disappearance of rural landscapes. Today, the landscape is considered a system of knowledge that encompasses various disciplines, with multifaceted meanings that reflect the interaction between natural phenomena and the impact human; it can represent the cultural expressions of a community or convey feelings about their own country, but also dreams and fears. In this cultural context, painting has a significant role in the expression of these human concepts.

THE LANDSCAPE IN GEOGRAPHY

Rougerie (1969) and Beroutchatchvili (1983) mention the history of the Science of Landscape, which witnessed many stages of evolution. It was in the Age of Genesis (1850-1920) that the first understanding of natural phenomena and landscapes began. The period of Biogeomorphological Development (1920-1930) brought more promising discoveries after the realization that other sciences also began to study how the elements of landscape interact. In short, a physical-geographic view (1930-1955) led to the birth of concepts such as the differentiation of small-scale landscapes based on tonality and in regionalization. The years between 1955 and 1970 were the era of the emergence of Landscape Ecology, which dealt with territorial issues such as taxonomy, classification and cartography. Landscape Ecology has undergone a major paradigm shift from the 1970 s to the present, integrating systemic and quantitative methods to define the concept of “Landscape” as a ecological system. Geoecological integration aims to study how landscape components interrelate to form a coherent stem and how biological and geographical principles can be an external aspect of an area or territory: considering the

landscape as an image synthesized into a scientific discipline (Geoecology or Ecogeography). Rougerie (1969) and Mateo (1984) formulated different definitions of the term landscape in French, German and Spanish, which are crucial to characterize it, which are: Landscape as that which represents one or another quality and which is associated with interpretation aesthetics, the result of diverse perceptions;

Landscape as a natural formation: formulated by the interrelationship of components and natural elements. In this sense, there are three groups of conceptions, namely: concept of genre of any level, using as homologous the terms: natural territorial complex, geocomplex or natural geosystem (PASSARGE,1919); regional interpretation, which conceives the landscape as one of the taxonomic units (usually the region) of physical-geographical regionalization; and typological interpretation, which conceives the landscape as a territory with common traits, which is distinguished by similarity; Landscape as an anthropo-natural formation: consist in gofer territorial system, composed of natural and anthropotechnogenic elements socially conditioned, which modify or transform the properties of the original natural landscapes. It is also formed by complexes or landscapes of a lower taxonomic level.

The conservation movement is both political and socio-environmental, also called the nature conservation movement, which mainly aims at the preservation of the environment. Originally, it was rooted in issues such as fishing, wild life management wild life and water resource control, and then moved to soil conservation and sustainable forestry. However, contemporary conservationism tends to focus on sustainable use of resources derived from the natural world and the preservation of biodiversity, in which protected areas become the main tools. Some people see conservation is mas part of an environmental movement broader, while others see it as separate movements with origins and unique ideological objectives. In several nations, such movements are viewed differently; in the case of the United States of America, they are often perceived as spheres completely independent. A prominent figure in the conservation movement was Rachel Louise Carson (1907-1964) who played a vital role, through her work "Silent Spring," during the 1960 s. In the 1950 s, she dedicated her efforts to raising awareness among people about what they were doing to the environment and the risks caused by pesticide pollution in America.

It is not that the book Carson(1964) wrote went unnoticed by many people because it not only questioned the practices of the scientific community and the policies of the American government, but also angered the chemical industry, however, it led all human beings to demand a change in our relationship with nature. Thus, we take into account what we call contemporary landscapes, including natural, anthrop natural, and anthropo-landscapes.

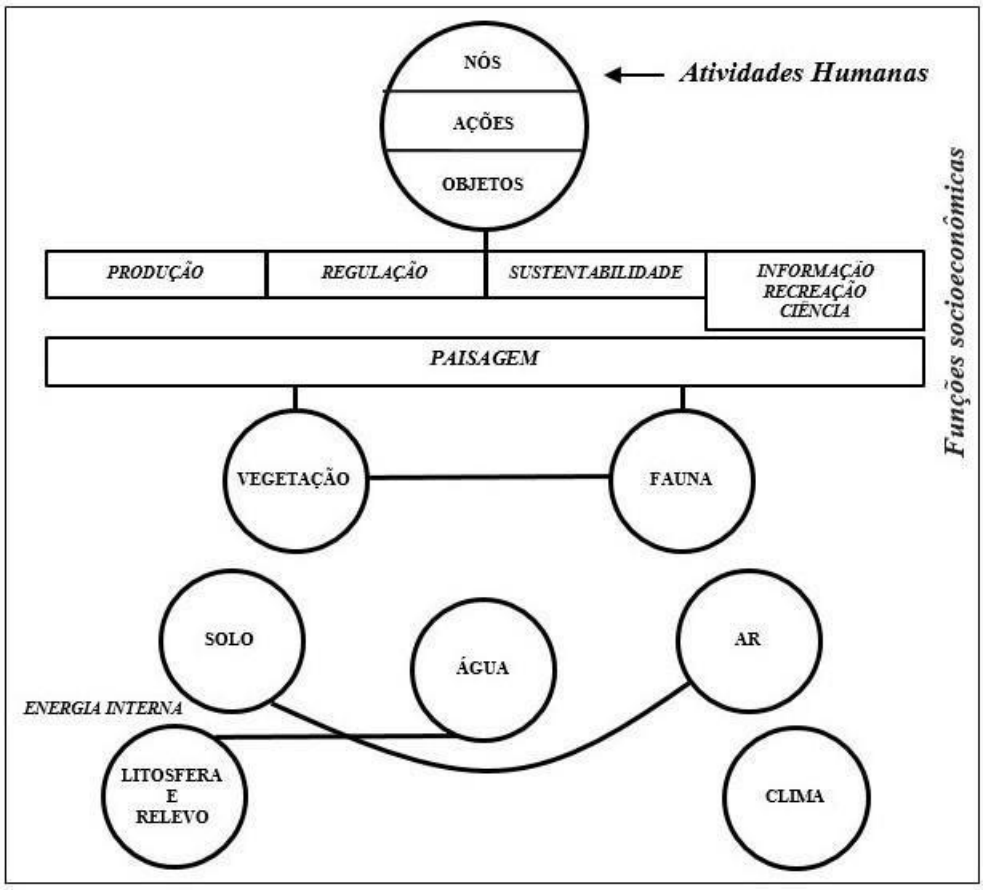

Figure 9–General model of landscape interactions.

Source: Adapted from Zonneveld (1986).

THE LANDSCAPE AS A SOCIO-ECONOMIC SYSTEM

A territorial complex in human geography is seen as the area of human life that incorporates certain processes of spatial interaction essential to the community, distinguishing this community by its specific ability to facilitate economic activities. In a way, it can be considered analogous to the social space, anthrop ecological system or complex productive territory, which considers natural and anthropogenic formations at a higher level and is mainly used by Human Geography (socio-economic), although it can also be applied by other branches that deal with social issues (OTOK,1988; GONZÁLEZ, 1996). The cultural landscape derives from the perspective that culture influences the natural land, thus evolving into a cultural group. In his argument, Sauer (1925) explains how culture is an integral part of the formation of a landscape and how this, in turn, shapes it – the environment acts as the end, while the cultural landscape emerges as the result. The landscape cultural takes shape in relation to the geographical characteristics of a place and is the result of these interactions. Individuals' understanding of the cultural landscape passes through the five senses and is at the same time affective and cultural. It serves to visually display territories in aspects sensory, emotional, symbolic and physical. Perception and the visual landscape emerge as the sensory nature of the environment through captured vision. It arises as a consequence of the mutual influence of physical, chemical, biological and human components. The perception of landscape is a mental representation that we have of the scene we see and feeling a certain moment. The value attributed to a landscape depends on the appreciation that a system or human group has for it. The concept of cultural landscape involves several aspects of study and reflects a system more intricate than the physical landscape, while embracing it and marking its presence. An investigation into the cultural landscape requires an appreciation of how societies shape nature, how they establish connections with their surroundings and what ideas they have about the natural world. Adopting an interdisciplinary position in relation to the geosystem can provide an understanding of the cultural landscape as a representation of civilization and of its relationship with nature. The concept of landscape as an anthrop natural formation is being investigated in areas such as geography and biology. The landscape is defined as a system of natural elements and anthropo natural

ones that protect and sustain resources, facilitate human subsistence, and also offer artistic appeal. In this way, the landscape is characterized by the following properties: the territorial community, through homogeneity in the composition of the elements that integrate it and the character of its interactions and interrelationships; the systemic and complex character of its formation, which determines its integrity and unity; the particular level of exchange of flows of substances, energy and information, which determines its metabolism and functioning; and the relative homogeneity of the spatial association of landscapes that territorially is characterized by a lower level, with regularities of spatial and functional subordination. Landscapes are sets intrinsically formed by their structure and patterns of the various elements that constitute them. They have many connections between them, both internally and externally, differing in status, vertical, typological and individual diversity. The landscape is not nature or culture, but a social construction that speaks about it, describes it and names it. A landscape can be seen from within itself; we can be both subject and object of the same landscape, stable, but in constant movement–changeable on some occasions and stable on others as well. Art and the use of land for agriculture and livestock have influenced historically the formation of landscapes. The term “landscape” dates back to its origins in the Germanic languages, particularly Dutch and German, but is understood differently in various disciplines. In the domains of visual arts, aesthetics, architecture and geography, landscape normally belongs to natural or cultural landscapes. Despite this consensus interdisciplinary, individuals' definitions of landscape are often shaped by their the rent complexity and their unique perspectives on it.

THE QUANTITATIVE REVOLUTION AND LANDSCAPE STUDIES

After the Second World War, large-scale changes occurred in the domains of technology, transport, economics, arts and science, which greatly influenced lives human. Geography also experienced noticeable modifications during this period. In the 1950 s, several geographers were dissatisfied with the regional approach to geography, considering it too descriptive instead of a general rule based on all the other sciences. Some geographers followed the quantitative trend presenting social sciences form any years and have

become important actors in this scenario, leading to acceptance of the quantitative approach as the main geographical methodology. The 1960 s marked a temporary decline in landscape studies, when geography began to turn to the creation and development of theories that would eventually help revolutionize geostatistical methods for spatial analysis.

In 1970, landscape studies returned with greater force, and the formation of the Research Group of the Landscape, in 1967, was seen as an essential step in this evolution. In 1972, the Working Community for Landscape Ecological Research (WLO) was created, and the Magazine Landscape was published in the Netherlands, with the aim of promoting interdisciplinary studies on landscapes.

The Berkeley School in the United States and some British geographers not only supported this vision, but also developed a landscape perspective that was firmly rooted in philosophy and attributed narrative and symbolic meanings to a level social. Also within geography and related disciplines, the International Association for Landscape Ecology (IALE), created in 1988, has played an active role in shaping of the discourse on landscapes and in advancing the understanding of them as key components of the environment. The introduction of geospatial technologies, such as satellite imagery and GIS, has had a profound impact on the scientific investigation of landscapes in geography, as it removes partially the human experience from consideration. However, nowadays, geographer's humans have discovered other ways to use these technologies more effectively in the landscape investigation. Marxist theory and Marxist geography are other important currents of studies landscaping. The contribution of Marxists to the field of landscape studies is highly appreciable. The Marxist perspective reveals that the landscape is politicized and contradictory, reflecting the struggle between capital and labor, between accumulation and sustainability. Your study requires unveiling the power structures that shape it, proposing anti-capitalist alternatives, such as collective reappropriation of the territory and the transition to a non-exploitative relationship with the nature. Their methods treat the landscape as a social and cultural formation that reflects a interaction between man and nature, and how we lath results from work; this relationship is called surplus value. In the field of geography, there have been critical Marxist scholars who focused on the landscape; some of them were: John Berger,

Raymond Williams, David Harvey, Don Mitchelland Denis Cosgrove. These geographers expressed that the creation and interpretation of landscapes are largely influenced by social and political relations, as well as the economic context.

REDEFINING THE TEXTUALITY OF THE LANDSCAPE

The influence of post-structural geographical research on the perception of landscape as a text has been substantial. Previously, peoples aw landscapes as merely objective and material. However, contemporary scholars understand that landscapes contain more than what is visible at first glance. In the 1970 s, cultural geographers began to explore the meanings under lying landscapes as texts. Yi-Fu Tuan expressed this thought in the early 1970 s, highlighting that physical entities are landscapes and, at the same time, also mental constructs. Later, in the 1990 s, questions arose about who writes landscapes, which ultimately led to a more flexible perspective on them. The concept of landscape gained a more complete view of how it connects to the human being and their activities. However, humanistic geographers turned to the study of landscapes in conjunction with the communities that live in them and their interaction with nature.

When dealing with landscape research based on qualitative and immersive methods, it allowed for a detailed consideration of all aspects and characteristics that made that particular location unique. Landscape research in geography has spread to other sub disciplines and ended up becoming interdisciplinary. The renaissance of landscape geography in the 1980 s was an eco-inspiration from the ecology of the natural environment. Based on post-modernism, but moving away from it, geography has increasingly embraced more and more a trans disciplinary approach to landscape studies, with the urban landscape as the main area of attention.

Author	**Landscape as aesthetics, nature, territory**	**Concept of Landscape**
Georg Simmel	Aesthetic Landscape	The landscape is born when there is a juxtaposition of natural phenomena scattered in the territory, which is apprehended in a peculiar type of unity, called *Stimmung*.

Author	Landscape as aesthetics, nature, territory	Concept of Landscape
		The landscape momentarily recomposes the unitary and homogeneous character of the whole, of nature.
Joachim Ritter	Aesthetic Landscape	The landscape is nature that becomes aesthetically present in the gaze of a contemplator (the wanderer).
José María Sánchez de Muniáin	Aesthetic Landscape	The landscape is an analytical and partial vision of nature that sight reaches, as well as hearing, touch, smell, and taste. It is spatial, entity-based, cognitive, and evaluative.
Ronald Hepburn	Nature Landscape	Nature needs to be appreciated and analyzed as nature, not only contemplated. One is in nature, one is part of nature, being both actor and spectator, and ingredient of nature.
Rosário Assunto	Nature Landscape	The landscape has a spatial and temporal dimension, in a limited and open space, as an object of aesthetic experience, by aesthetic judgment. Its existence depends on the naturalness of its elements, from historical to industrial.
Nicolas Grimaldi	Aesthetic Landscape	The landscape should be reconsidered through nature, in forms disinterested in order to perceive its beauty.
Alain Roger	Nature Landscape	The landscape is an extension of the earth, a spatial whole, which acquires aesthetic value when the human subject perceives and internalizes it. It is a perceptional work of the subject.
Augustin Berque	Nature Landscape	The landscape is the sensitive and symbolic dimension of nature, which always depends on collective subjectivity, and where there is no culture, no landscape exists.
Eugênio Turri	Territorial Landscape	The landscape is the representation and iconic naming of the territory, revealing the subjective meanings of the historical-cultural values of territorial identity.
Allen Carlson	Aesthetic Landscape	Aesthetics must provide supporting points to appreciate the landscape, based on the natural sciences.
Yuriko Saito	Aesthetic Landscape	The landscape should be appreciated with the incorporation of bio-regional narratives, in addition to scientific knowledge.
Malcom Budd	Aesthetic Landscape	Nature should be appreciated as it is. It must be recognized as having been formed by physical, chemical, geological, ecological, meteorological, and evolutionary processes, all happening independently of the observer.
Arnold Berleant	Nature Landscape	The perception of nature, besides being visual, is also a somatic commitment in the aesthetic and ethical field

Author	Landscape as aesthetics, nature, territory	Concept of Landscape
		(de-commitment).
Martin Sell	Aesthetic Landscape	The landscape is nature perceived aesthetically.
Paolo D'Angelo	Nature Landscape	The landscape as an aesthetic phenomenon is marked by the biological-scientific and culturalist doctrine. Aesthetic identity is always the result of interaction between nature, culture, history, and evolution with the landscape.
Luisa Bonesio	Aesthetic Landscape	To understand the beauty of the modern landscape, it is necessary to see the landscape as a manifestation of the modalities of inhabiting man on Earth.
Gonçalo Ribeiro Telles	Nature Landscape	Harmony of the environment consists of developing biodiversity, transformation, circulation and permanence of water, transformation of energy, favorable microclimates, improving disordered systems, protection of species, which make up the landscape.

Table 2– Synthesis of the lines of landscape thinking related to aesthetics, nature and territory. Source: Vieira (2014, p.43).

Tuan's interest lies in nature in its own environment and he does not seek to impose his definitions. For him, nature is a term juxtaposed to culture and society. In the essay "Nature" that Tuan revised, the landscape is linked to nature, which, obviously, is very disappointing for him. On the other hand, when studying various European and Chinese notions of human beings living among nature, the writer explores what is referred toast he essence of the landscape. Tuan argues that, from the European point of view, nature is seen as human property and the man is free to explore it. In contrast, the Chinese consider themselves part of nature in search of balance and harmony. According to Tuan, both the 18 th -century European garden and the Chinese garden are human products. He states that culture means the power of human beings over the environment natural, which can be well appreciated in front of natural landscapes. Although Christian ethics saw in nature a reflection of divine perfection, later, after the Renaissance, people began to see nature as a gift from God intended to satisfy human needs. From a scientific point of

view, nature is important not only for human beings, but also for other living beings. The basis of the philosophies of the 17 th and 18 th centuries was in nature and reason as an order and harmony that situated man within nature itself. In the 19 th century, with rapid urbanization and industrialization, science began to recognize the natural environment distinct from the artificial environment. This marked the birth of environmentalism, which examines how nature affects people. In the history of art, Renaissance landscape painting played a role in shaping the conception of landscape as a visual theme. This happened because, at that time, painting shifted its focus from man to nature. Such a beautiful and naturally demarcated areas to do us. Note well that academic geography and an academic concept of "landscape" have a simultaneous and common origin, an origin that greatly expands the first conception of "landscape" in Western thought, which emerged in the Renaissance, associated with new techniques of space representation, from the projection in perspective based on one or two vanishing points, which would renew the principles of painting and other artistic techniques that propose to reduce space to just two dimensions (HOLZER, 1999, p. 151).

The etymology of the word "landscape" goes back to the German term "landschaft", which originally referred to natural landscapes such as hills or forests. On the other hand, the adoption of English gives the term "landscape" an aesthetic sense that does not focus only on the singularity or visual exceptionality. Tuan (1966 a) pointed out that this was part of the evolution of geography towards a more humanistic perspective, in its efforts to enrich existing ideas about the landscape, addressing its birth and other elements. In the architecture, spatial forms shape the landscape, while geography sees it only as raw material for understanding human life, without considering rhythms and life cycles or distinctive characteristics of specific landscapes. Consequently, Tuan (1966 a) argues that these factors need to be taken into account if we want to go beyond these limitations. Landscape is more than natures up rim posed by the material expressions of human life. It means more to us than the sum of the material facts of hills and valleys, fields, roads, bridges, churches and houses; for in addition to scientific and economic evaluations, we impute to the landscape contents that can only be described as psychological, religious, aesthetic and moral (TUAN, 1966 a, p. 31).

The landscape is the result of the combination of vision, natural elements, culture, perception and attitudes. It has become increasingly important in the studies of science geographic. Geography has a term that seems to memo cupric her and more appropriate for your field of study [compared to the term environment]. This word incorporates into the physical support the traces that human work, that man as an agent, and not as a mere spectator, imprint son the sites where he lives. More than that, it denotes the potential that a certain physical support, from its natural characteristics, can have for the man who proposes to explore it with the techniques at his disposal. This is one of the essential concepts of geography: the concept of “landscape”.

In the seminar, Tuan argues that the landscape is not just a visible reality in the world; it is also created mentally and as an abstraction of reality. You have to look at the part with due attention to the whole. It can only be seen by a person who understands and distinguishes another person from her. The boundaries of a part of the landscape are not so clear. The core of the landscape, about which Tuan (1966) wrote through out his professional life, was systematized in Figure 10, below, and consists of all the elements and principles that over lap and merge into a visual landscape.

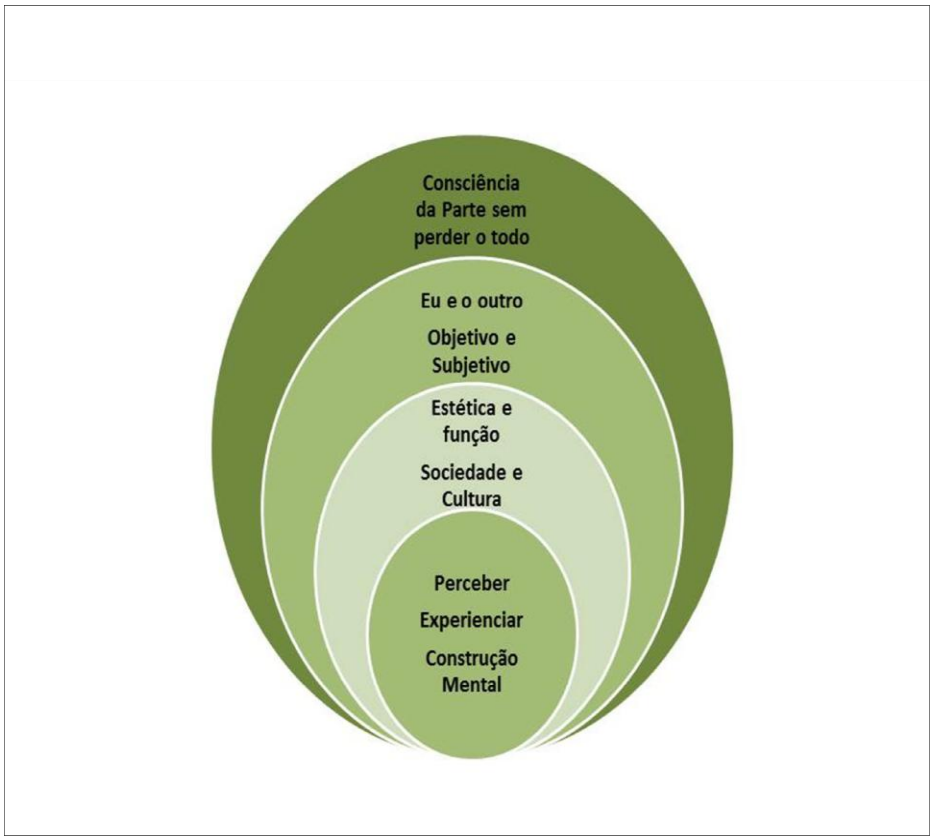

Figure 10–Principles that over lap and merge in a visual landscape.
Source: Tuan(1966 a).

Although we are all human, each one feels a world of their own, very different, because of the body. But what we feel changes from person to person: one can hear very well, another may see somewhat poorly. The way the brain understands things is also unique, it is not the same for everyone. And culture and the place where we live greatly change how we feel things and how we use our senses in everyday life. Those who live in the cold, like Eskimos, see a lot of different types of white snow, because they live the rein the middle of it. Those who live in the Amazon, on the other hand, hear everything very well, because of the forest full of trees. In the end, each sense changes the way we see the world and how we act with what we see around us. Hearing, smell, taste and touch are close senses. The worlds known through them tend to be cozy and moving. All four senses intimately involve the individual with the place–with a person's immediate environment [...] Vision is our most active cognitive sense (TUAN, 1984 b, p. 8).

“It also seems to be the least emotional – the ‘coldest’ – of the senses, perhaps in part because the visual field does not involve us. We only see what is in front; we are necessarily on the margins of our own visual field”.

It is possible to perceive that vision distances us from things. We don't need to be close to see. According to Tuan (1993 d), vision does not awaken emotion, it only transforms us into spectators. When we look at the city through a closed window, we see the world, but it seems static, distant, and lifeless.

CHAPTER VI

THE PROTECTION OF NATURE AND THE LANDSCAPE: A VISION OF CONSERVATIONISM FROM DOMAIN TO PROTECT

Contrary to the common belief that conservation is a phenomenon exclusive to the era modern, its origin lies in the scientific understanding of biodiversity and the response to threats contemporary, such as the depletion of energy resources, climate change and degradation of the ozone layer. The roots of environmental protection, as we conceive it today, date back to the Erath at preceded industrialization–the late 18 th and early 19 th centuries. In fact, this concern is an attribute of its time and could not have existed in the same way in other times. In his book entitled "Man and the Natural World", Keith Thomas investigates the evolution of attitudes towards nature in Great Britain, known as the first nation industrialized to adopt conservation practices. This change was a consequence of the effects of economic development on the negative ecosystems of industrial development and of the growth of cities. Historian George Macaulay Trevely an described this change as a rapid deterioration, where natural beauty was no longer the result of conditions normal economic (THOMAS, 1983). The only remaining hope was to preserve what still had not been destroyed. In this insightful quote, it becomes obvious that the conservation models known previously have two essential characteristics. The first focuses on assessing beauty natural and its perpetuation for human benefit. On the other hand, this innovation–animals, plants and landscapes identified as entities holding intrinsic rights– calls into causes the validity of using nature only for your satisfaction. Another feature deals with emergence of conservation practices where conservation was considered a strong approach to "save what has not been lost". In the United Kingdom, this was achieved through the formation of parks and game reserves. In America and later in other parts of the world, natural parks were created to some authors consider that the roots of the movement for protected areas date back to antiquity. Colchester (2000) states that game reserves appeared in Assyria as early as 700 BC, and in India around 400 BC. In Europe, according to the author, the idea would be introduced in the 11 th century

ensure they were not adulterated and polluted by human activities. These areas protected also ensure that resources are protected.

CHANGE OF SENSITIVITY

A feeling of uncertainty regarding human domination over nature arose in the late eighteenth and early nineteenth centuries. The origin lies in the deterioration of cities industrial, in the expansion of cultivated agricultural land, in deforestation, in the destruction of natural habitats and the extinction of species of wild animals. There have been many arguments that these causes have led to greater awareness of this issue, mainly in England, as well as in many European states. Furthermore, during that period, society also underwent moral and aesthetic changes. The cities with their coal-burning industries were suffocated by pollution and by the dust that only the environment could all aviate. It was also are fudge from immorality, to where people fled because it represented goodness, purity, innocence and simplicity. In contrast, the deep attachment to wild life and unaltered natural landscapes emerged as more than an antidote to extreme deforestation and other forms of environmental degradation unsustainable, but also acted as an ideological aspect that facilitates moral evolution and aesthetics in the way humans relate to nature. During the century prior to the eighteenth century, land management was seen as a means of restore the lost paradise of Eden. But, from then one, it was found that any part of the nature had to be left alone because if God made such things, surely everything in this world must have a purpose and therefore deserves protection. Even the eradication of species, whether harmful or not beautiful, would supposedly destroy Divine harmony and disrupt artificially the natural order. As a result, a miner – one who belongs to the people truly simple of the mountain–is nothing less than nature untouched by the life that he exercises in the natural environment. He drinks water from fresh springs, breathes the air that flows over the peaks of the Alps and eats what he can find at the time. However, this individual does not reside in a urban environment, but rather in a wooden cabin full of animal skin. It is Thomas (1983) who says that the dark side of the charms of nature and life wildlife comes from its compensatory value to the vices of civilization. In that view, the efforts of conservation were divided into two: use and

preservation, artificiality and naturalness. William Gilpin in Thomas' book gave an expression that would be a good testimony to this thought, stating: “Wherever man appears with tools, the transformation follows”. On the other hand, moral concern prevented the desire to preserve untouched habitats that seemed to fight against civilization. “Artificial oases or fantasy worlds” we recreated by the establishment of areas protected, development of urban spaces, green belts and animal sanctuaries that reflect “the values by which we live every day” on a basic level. The park model American was based on similar ideas with the intention of developing its form contemporary that would define the modern concept of conservation. A religious principle contributes to the contemporary understanding of the concept of ecological balance which is only later confirmed by scientific arguments. Furthermore, the transition from morality to personality through natural value and rebirth spiritual is also reflected in new aesthetic experiences. A growing sense was represented by British horticulture, which grew attracted by excessive sophistication and artificiality to the detriment of formality. Similarly, wilderness areas, with high mountains between them, were seen as having a “sublime” nature. The mountains, during the 16 th century, were considered “the abode of the gods and of demons”, assign of the chaos and turbulence of the Earth. Gradually, fear turned into fascination with the mountains, because they came to be considered not only as charming elements, but also invigorating and works of higher powers. In romantic literature, Addison, Steele and Shaftes bury built the vision of end owing the mountains with “archaic” grandeur, while the paintings of rugged landscapes in Italy by Salvatore Rosa also fueled this change; furthermore, accounts of English travelers about Lake District, Scotland, Walesor the Alps contributed to this change. Visit mountains became an act that indicated not religious admiration, but respect for their power. In this way, almost by instinct, we have become accustomed to making our presence felt next to the beauty of these forms, establishing a close relationship. A man was trying to research purposefully his own solitude and with sublimity–it was thought that only in this way would it be possible to understand the nature of sensory experience.

THE AMERICAN VISION OF CONSERVATION

The settlers who arrived in the United States did not find many Native Americans because they had died of European diseases or did not feel attracted to colonize the land. In ethno centric terms, the colonists assumed that indigenous peoples were barbarians and inferior. Investigations in to the use of wilderness began in the century XIX. The wilderness seemed more different from the society of decadent Europe than an American imagined himself through symbolic elements. Furthermore, wilderness has been fundamental in the formation of the conservation movement and in the development of national parks in America. Diegues (1994) states that theorists, activists and musicians such as Thoreau and Muir believed in the struggle for the conservation of biodiversity and the establishment of park sat the national level. The painters Albert Bierstadt, Carlton Watkins and Ansel Adams also helped to promote the importance of these American lands through their landscape art, which highlighted the beauty of the western United States. Consequently, they valued these American places. Schama's presentation (1995) on this administration of American icons, however, is a fascinating read. For him, the two parks created a spur sanctuaries natural where people can enjoy and find pleasure in nature are the National Park of Yellowstone and Yosemite National Park. However, what seems to escape much attention is that these sites have been ancestral homelands of indigenous peoples for hundreds or thousands of years–the Shoshone and Black feet in Yellow stone or the Ahwahneechee in Yosemite. The emergence of these principles, although they have grown with great power, has not achieved universal acceptance without any difficulty, even in its early days. The question of these principles was first raised by the artist George Catlin during the early 19 th century, when he argued that buffalo and Native Americans were dying and needed protection. Similarly, a German forest engineer named Gifford Pinchot proposed the concept of rational use of resources that marked the beginning of the ecological movement. The current that I will describe here was also inspired by the nature preservation current of John Muir, who is known as the father of nature conservation. This debate between conservationists and advocates of resource exploitation still maintain sits significance to this day. Given the emerging notion of sustainability, it seems valid that Pinchot's vision presented in 1992 on the

rational use of forests is correct. However, the plan of natural preservation in America is based on a conservationist approach. Is definitely associated with the domain of untouched nature, which becomes a reference for this sector. Photo 2 was taken in Yosemite Valley in the United States of America, through Ansel Adams' camera.

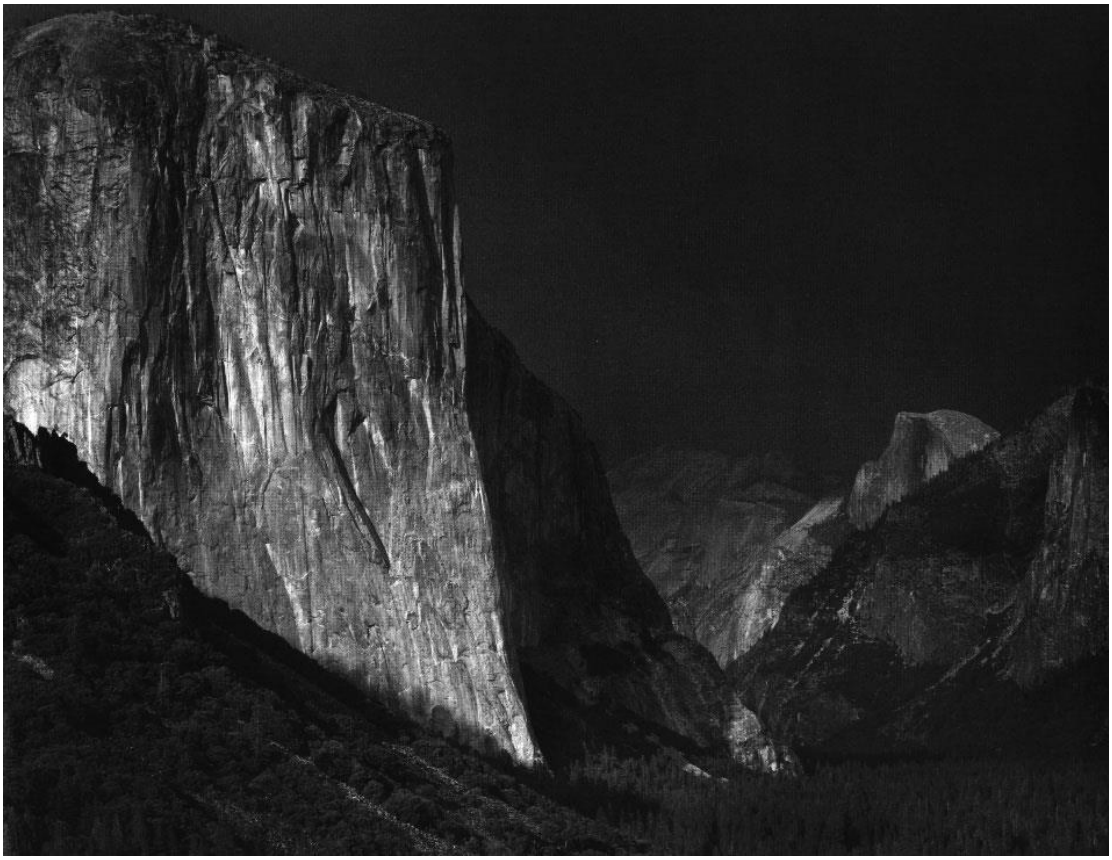

Photo 2– El Capitan, Half Dome, Clearing Thunderstorm, Yosemite Valley.
Source: Adams (1972).

Carson (1964) was an ordinary person with problems like all of us; she had to face lack of money, family responsibilities and struggled a lot to find her job. Still, this burning passion and courage transformed her into a woman possessing extraordinary characteristics. Her studies with animals led her to become one of the best-known American naturalists. Her most famous writing, “Silent Spring”, emerged to show how pesticides were lethal in the Cold War era, and this book was met with strong opposition from the chemical industry. Appreciated for her professional life and worthy

achievements for the global ecological cause, she became an immortal part of history. Born on May 27, 1907, Rachel Louise Carson was the daughter of a farmer named Robert Warden Carson and a mother known as Maria Carson. Her mother, who also loved natural history and bird watching, introduced her to the joys of observing nature. Although her family faced challenges financially, Rachel Carson managed to complete high school and continue her studies, which her siblings did not have the opportunity to do. Coming from Pittsburgh, she graduated from Pennsylvania College for Women, where she developed her passion for writing. Even as a child, Rachel always dreamed of earning life's ending articles to magazines and receiving awards or scholarships. She was also someone who seemed isolated with few friends, and some of her teachers were particularly close to him for whatever reason, such as one of them was Ms. Marie Scott Skinker, who taught Rachel Carson the first biology course of her curriculum. She vehemently condemned the school's emphasis on training women only for good prospects for other hood and marriage, while paying little attention to science. Moved by great respect and sympathy for Skinker, Rachel Carson decided to abandon her majoring in Chemistry and studying Biology. At the end of the second year, she got a grade maximum. Even though he received his doctorate from Johns Hopkins University, this teacher was unhappy when the next one came after her, because it seems he didn't have much love or interest in science. During this period, there was no motivation for women to enter science. It was in 1927, when Racheland Skinker made an attempt to get a master's degree in Hopkins, but the scholarship they received was not enough to cover transportation expenses and housing in Baltimore, Maryland. Consequently, they ended up spending one more year at university. She received a scholarship the following year, which allowed her to pursue zoology studies at the university level. Going back home wasn't so easy after that she left home when she was young, because her parents were still there. The old glue factory, which smelled bad, disappeared from Spring dale and a new one is in its place. This was at a time when coal processing plants were expelling gases thick with a distinct and pungent smell of sulfur. One of the most recent initiatives in the city was also instigated by West Penn Power Company, which served as an alternative to Duquesne Light and the more polluted Allegheny Power Company; she mentioned that they were competing with each other for the title of who could pollute the river more.

One of the marine biologists from the Marine Biological Laboratory (MBL) in Woods Hole, Massachusetts, began her research after attending a full eight-week course there, which is a community scientific founded in 1888. The moment Rachel Carson had her first glimpse of the ocean was at that moment: when asked about how she saw the ocean for the first time, she told the reporters that it was shortly after she left her father's house in Springdale and moved to school. She was so fascinated with what she found there that she gave up everything she had done before and began studying science in general and marine biology specifically. Being Skinker the place where Rachel Carson began her studies at Hopkins, she had to leave when the professor, who was supposed to supervise her work, fell ill and went to Washington DC. Rachel Carson suggested that they move to Baltimore because it would be a better opportunity for them. She received a scholarship for her freshman year, but had to get a job in her sophomore year because fees kept rising. Now she is a lab assistant at the college, researching and conducting experiments with reptiles and fish; she finished her studies and received her master's degree in 1932.

During her research and writing process, Rachel Carson faced a myriad of obstacles. Initially skeptical, it was only after conducting extensive investigation that her opinions began to change. Even after being rejected by a magazine, she decided to publish a book to share her ideas with more people.

In 1958, Houghton Mifflin had a contract with her; however, due to health problems, publication was delayed. She suffered from ulcers, breast cysts, malignancy metastatic and lymphoma, and also underwent radiation sterilization. Even being severely ill, Rachel Carson perceived the bookcase duty and continued to work on it without giving in. Rachel Carson became the target of criticism from those who disagreed with the decrease in the use of pesticides when the project was discussed. However, when Silent Spring was published in 1962, it was harshly criticized for what critics considered an attack on men and subject to obscene epithets. Furthermore, from persistent bone cancer, she suffered fractures that left her unable to walk or write. Despite the many difficulties Rachel Carson had to face, she still struggled and worried about who would become her nephew's guardian in the even to her death. It was Paul Brooks and his wife who took in the child. Rachel Carson passed away due to an infection pulmonary, but defended mother nature, leaving an impactful legacy. The translations were published in German in

1962; in French, Swedish, Danish, Dutch, Finnishand Italianin 1963; in Spanish, Portuguese and Japanese in 1964; as well as in Icelandic in 1965, Norwegian in 1966, Slovenian in 1972, Chinese in 1979, Thai in 1982, Korean in 1995 and Turkish in 2004 (STOLL, 2012).

STOLL, M.“Rachel Carson’s Silent Spring, a Book that Changed the World. ”Environment & Society Portal, Virtual Exhibition, 2012, n.1[February 6,2020]. Version 2.0. Rachel Carson Center for Environment and Society. Original text: “[…], a reporter noted public concern about the use of pesticides and asked [President John F.] Kennedy whether he had directed ‘the Department of Agriculture or the Public Health Service to take a closer look at this.’ He responded, ‘Yes, I—and I know that they already are—I think particularly, of course, since Miss Carson’s book but they are examining the matter.'

MAN AS PART OF NATURE

The likely scenario is that this perspective dominates the contemporary world, but it is only one among many. This ideology was subdominant in its development stages and later transformed into an integrated view between human beings and nature (NAZAREA, 1999). There are still some opposing views that suggest means by which the duality perceived between humans and the environment can be overcome. Talking about the contrast between nature and society in primitive societies is irrational. According to Descola (1997), Amazonian indigenous peoples lack an ontological difference that separates humans, plants and animals in their worldviews. In this framework of life, all creatures are linked to each other through a set of intermediaries where personal autonomy, including the spirit, becomes totally dependent. This system also considers biodiversity, essential for the survival of indigenous and traditional communities, but it is not seen as a mere resource. Although it is studied systematically and its importance lies in its utility, it also has value symbolic. These values are an integral part of their cultural perspective. Furthermore, Vincent Scully (1991) also reaches the same conclusion in his investigation into territorial systems and styles of pre- Columbian peoples such as the Aztecs, the Navajos and the Pueblos. In his opinion, the distinctive structures of these

civilizations do not clash with nature through isolation from it and the human being. Instead, they accentuate the natural elements in shape, color and arrangement. These structures also have ritual functions that symbolically incorporate human beings into the landscape, but also emphasize some natural aspects necessary in all human endeavors.

CHAPTER VII

CURRENTS OF ENVIRONMENTALISM: THE PRESERVATIONISM AND THE CONSERVATIONISM

The origin of the term sustainability dates back to 1713, in Saxony, where Captain Hans Carl von Karlowitz used it for the first time. He saw this as a strategic concept, since the region had several mining furnaces that needed charcoal and forest wood proved to be an excellent resource; this undoubtedly encouraged development. A document written in Latin – the language of culture at the time – was entitled “Economic Silviculture”, a work on forest sustainability; this is what Karlowitz wrote. The objective of this text was to encourage the economic use of wood so that forests could be properly managed and not become depleted resources. In his book of 1795,“Informationonthe Determination and Description of Forests”, he emphasized that forests were as important to future generations as they are today. Likewise, Karlowitz's idea resembles that of sustainability contemporary, where we only take what the forest can support and all witty regenerate. According to Ingo Sarlet (2020), the State used to have an interest in ecological protection, but this interest was mainly associated with economic profit ability or threats to public health and safety. Originating from the ideas of a magical imaginary concept, ecology emerged as a self-governed field. It became recognized as an area of study in the 19 th century, and the word “ecology” was introduced by Ernest Heinrich Haeckel. After the explosion of urbanization of Industrial Revolution, governments had to fight for values not only economic, but also aesthetic and the natural value of their nation's lands, in order not to fully utilize this potential. The origin of the current system of protected areas in the United States dates back to the founding of Yellowstone National Park in 1872. Environmental destruction and deforestation caused by agriculture and livestock

were promoted by Abraham's Homestead Act Lincoln, which encouraged settlement in public areas lands. On the contrary, the movement transcendentalist disapproved of this destructiveness against nature, seeing nature as the priority of reason maintained during the Enlightenment. The same was achieved through the formation of governmental protection units environmental that combine the element of environmental protection with public policies. Furthermore, Yellowstone National Park is known to be an example to follow because it was established as the first national park in the world.

THE BRUNDTLAND REPORT AND SUSTAINABLE DEVELOPMENT

According to Diegues (2000), American transcendentalism has been influential in the formation of the idea of "wilderness", seeing it only as nature, devoid of any human traces. But science, Charles Darwin and George Marsh noted, disputes this vision; after all, man is a product of nature. Specifically, Darwin's writings proved that the belief that humans were a special creation of God above nature is wrong and does not stand up to close scrutiny. During the 19 th century, the creation of large areas controlled by the State under the philosophy of wilderness played a fundamental role in shaping and defining Conservationism as an ideology. This ideology defends untouched nature almost to such an extent that no one can imagine such idealized landscapes free from any interventions human. According to current information, the hot spring reserve emerged in 1832 and only until 1921 was it recognized as a national park. The idea of conservation was implemented with the creation of the National Park of Yellowstone in 1872, which became known as the first national park in the world. This was one of many contemporary legends considered by Diegues to help urban population to experience the tranquility and beauty of untouched landscapes. By a law that gave rise to Yellowstone National Park, this place should remain property public and playground, without any element of a lie nation having a chance to happen, as it is a great piece of happiness that benefits humanity as a species. Any individual who arrived there with the intention of staying permanently or would be temporarily seen as an intruder and expelled. The Department of the Interior takes care of protecting the park's treasures. Furthermore, the area has long been managed according to human convenience, which is mainly done

through the introduction of fish species that would help control herbivore populations such as moose and others. However, there are laws and regulations, which have been made and it is necessary comply with them to ensure that nature remains in its original condition in the area. According to the results of José Luis Andrade Franco's research (2013), previously there was no awareness of the loss of biodiversity caused by habitat destruction and extinction of species. Before 1985, activists were concerned with preserving wildlife, not were interested in defending the independence of the wilderness, but also its facets of beauty. The unhealthy conditions of the time inspired most to establish our first national parks and environmental reserves. In the modern world, protection of the environment is not an imposition or, indeed, even a choice for future generations, but it still exists, at least now. If current trends in world population growth – industrialization, food production and depletion of natural resources–continue unchanged, the limits of growth on this planet will be reached someday within the next hundred years. The most likely result is a sudden and uncontrollable decline, both in population and in industrial capacity (BRUSEKE, 1998, p.30).

The Club of Rome believes that if developed countries unite to protect the environment, the gloomy future will become less frightening and the environmental balance will stabilize. This is the second most important statement. It is possible to modify these growth trends and form a condition of ecological and economic stability that can be maintained into the distant future. The state of global equilibrium could be planned in such a way that the basic material needs of every person on Earth are met, and that each person has the opportunity to realize their individual human potential (BRUSEKE, 1998, p. 30). Furthermore, environmental protection also requires public participation, as mentioned in article 3. If the world's population decides to commit to obtaining this second result, instead of striving for the first, the sooner it starts working to achieve it, the greater its chances of success (BRUSEKE, 1998, p. 30).

Developing countries see a higher level of protection of the environment as a restriction on their industrialization efforts. Figures like Solow, Nobel Prize laureate, and Southern experts like Mahbub Haq criticized the Club of Rome document, pointing out that, after a hundred years of rapid growth of the Western society, this is not over yet. At the Stockholm Conference, were presented proposals on a new development model that

harmonizes economic growth and environmental protection. In 1973, Maurice Strong proposed a concept called eco-development. This innovative approach to development is known as ecological development. Ignacy Sachs proposed six principles that should be incorporated in national development policies to guide countries on how they can achieve this new paradigm. [...] a) satisfaction of basic needs; b) solidarity with future generations; c) participation of the population involved; d) preservation of resources natural resources and the environment in general; e) development of a social system guaranteeing employment, social security and respect for other cultures, and f) programs of education (BRUSEKE,1998, p.31).

The main objective of the Strong and Sachs plan is to offer assistance to nations in development, commonly referred to as the Third World. However, the idea of ecological development may be more of an idealism that cannot be realized, especially with regard to industrialized countries. This may be due to the fact that Sachs seems to disregard capitalism and also the history that existed at that time, which is the competition between Western capitalist countries and Eastern European socialists. The birth of sustainable development was supported by the notion of eco-development and became a path for others. The World Commission on Environment and Development was convened after the Kokoyok Declaration of 1974 and the Report Dag-Hammarskjöld of 1975. This important event was marked by Our Common Future or, as it is also called, the Brundtland Report, named after the president Norwegian of this committee, Gro Harlem Brundtland. [...] part of a complex vision of the causes of socio-economic and ecological problems of global society. It underlines the interconnection between economy, technology, society and politics and also draws attention to a new ethical stance, characterized by responsibility both between generation sand between contemporary members of today's society (BRUSEKE,1998, p.33).

The report also establishes measures that should be taken at the national level on this issue, such as: [...] limitation of population growth; b) guaranteeing long-term food; c) preservation of biodiversity and ecosystems; reducing energy consumption and developing technologies that allow the use of renewable energy sources; e) increasing industrial production in non- industrialized countries based on ecologically adapted

technologies; f) controlling wild urbanization and integration between countryside and smaller cities; g) basic needs must be met (BRUSEKE,1998, p.33).

In addition, it highlights the objectives that need to be achieved at the global level, mainly through various international organizations, emphasizing the following points:

[...] h) development organizations should adopt the sustainable development strategy;

i) the international community must protect supranational ecosystems such as Antarctica, the oceans, space; j) wars must be banned; k) the UN must implement a sustainable development program (BRUSEKE,1998, p.33).

The Brundtland Report continues to be very important in the field of development sustainable. The impact can be seen in debates about how to balance growth economic, environmental protection and social justice. As the development agenda sustainable advances, the principles established in the Brundtland Report will continue to guide future actions and policies. According to Figure 11, one can observe a synthesis of reasoning of the meaning of the Brundtland Report.

Figure 11 – Reasoning Synthesis of the Brundtland Report.

Source: Sehyeon Baek (1987)

In recent years, sustainable development has become a very important. It encourages significant changes in different areas of people's lives to reduce their impact on the environment. In 2015, the United Nations General Assembly established 17 global goals, namely the Sustainable Development Goals (SD Gs). Figure 12 identifies the 17 goals, as mentioned in the Assembly to be applied in Brazil until the year 2030.

Figure 12 – The 17 global goals to be implemented in Brazil by the year 2030.
Source: United Nations Brazil (2024).

The SD Gs are a set of progressive goals for social progress, addressing challenges such as poverty eradication, gender equality, biodiversity protection and fundamental policies. Cooperation is essential to achieve these goals. The structure of the SD Gsis complex, but higher education in situations have the potential to promote social and environmental well-being, improve decision-making and focus on efficiency without compromising public policies. Regarding sustainable development itself, from a historical point of view, according to Allonda Ambiental and sustainable development, its chronological evolution happened from: 1948–Universal Declaration of Human Rights–Shortly after the end of

World War II, the Universal Declaration of Human Rights was prepared in Paris by representatives of different cultural and ideological backgrounds. Declared on December 10, 1948, it is the most translated document in the world, and can be found in more than 500 languages; 1956–Minamata Disease, Japan–The city of Minamata, Japan, suffered intense mercury contamination, from industrial waste in its bay, carried out by a company installed in the region in the 1930 s. The first cases appeared in 1956 and, in total, hundreds of people fell ill, some fatally, from consuming contaminated fish. In 1973, Chisso became the first company in history to be held responsible for a disaster environmental, being sentenced to pay more than 600 billion dollars to the 138 people who filed a lawsuit against her; 1962–Silent Spring–Biologist and writer Rachel Louise Carson released, in 1962, Silent Spring, a book that started a true ecological revolution by drawing attention to the effects of pesticides on nature, painting a future scenario of complete devastation; 1972–Stockholm Conference and Limits to Growth Report– Prepared by a team from the Massachusetts Institute of Technology (MIT), in early 1972, the Limits to Growth Report had a major impact on the first World Conference on the Human Environment, held in the same year in Stockholm, Sweden. The discussion revolved around the need to impose limits on the exploitation of natural resources, as the world population and industry grew at an increasingly accelerated pace; 1983–Brundtland Commission– The physician and former Prime Minister of Norway Gro Harlem Brundtland was invited in 1983 to chair the Commission World on Environment and Development, composed of experts from various areas, with the aim of deepening global proposals aimed at the environmental area; 1984–Bhopal Accident, India–On December 3,1984, a factory of the American company Union Carbide, located about five kilometers from Bhopal, India, had a serious gas leak, which created a toxic cloud responsible for killing 3,500 people, according to the government. Human rights organizations say the number of fatalities reached 25,000, considering the following years. In 2010, seven company employees were convicted of the accident; 1986 and 1989–Chernobyland Exxon Valdez Accident– The second half of the 80 s was marked by two major ecological disasters: Chernobyl, in the former Soviet Union, now Ukraine, and the Exxon Valdez, in Alaska. In April In 1986, one of the four reactors at the Chernobyl nuclear power plant exploded, spreading radiation around the plant, killing at least 15,000 people.

The city of Pripyat was completely evacuated and is now an abandoned place still under radioactive effect. Three years later, the supertanker Exxon Valdez hit against an ice block, spilling 36,000 tons of crude oil into the waters of Alaska, contaminating fish, birds and beaches within a radius of up to 750 kilometers from the accident site. Pressure from environmentalists and public opinion made Exxon disburse US$1 billion in a task force to clean up the damage caused by the disaster, an operation that lasted six months; 1987–Brundtland Report–Our Common Future–In 1987 the Commission World on Environment and Development, created in 1983, published the report Our Common Future, one of the first documents to bring to public the concept of sustainable development; 1992–Rio 92 Conference–Known as ECO-92, the United Nations Conference United Nations on Environment and Development took place in Riode Janeiro, in June 1992. In it, for the first time, the international political community admitted the need to think about economic development also from the point of view environmental and social. It was at this meeting that some were established new consumption patterns such as, for example, reducing the use of fossil fuels; 1994–Triple Bottom Line Concept–The concept of the Tripod of Sustainability was coined by the British John Elkington, sociologist and consultant who stated that sustainability must be understood and treated through three basic pillars: environmental, social and economic. Therefore, companies, especially, must seek to base their actions in order to work these three concepts harmoniously in search of real development sustainable; 1995–Deactivation of the Brent Spar Platform–In April 1995, activists from Greenpeace occupied the Brent Spar oil platform asking for the cancellation of its sinking in the Atlantic Ocean. After 52 days of protests and negotiations, it was decided that the platform would be dismantled. Its parts were used for the construction of a pier in Norway; 1997–Kyoto Protocol–Written and signed in the city of Kyoto, in Japan, the Kyoto Protocol is an international agreement between the member countries of the United Nations (UN), which undertake to reduce the emission of gases that cause the green house effect. The protocol created guidelines aimed at reducing the environmental impact caused by industrial development; 1998–Launchofthe HDI–The first Human Development Index report was launched by the UN in 1990, with the aim of analyzing and measuring how people live through three basic factors: longevity, health and income.

Until then, the main parameter of development was the Gross Domestic Product (GDP), a purely economic perspective that did not take into account social and political values. But, in 1998, Brazil was one of the first countries to adapt the HDI to the municipal level, which guarantees a more refined index; 2000 – Cartagena Protocol and Launch of the MD Gs – In the year 2000, the Conference of the Parties to the Convention on Biological Diversity (CBD)adopted the Cartagena Protocol on Bio safety, which seeks to ensure a level adequate regarding the use and movement of living modified organisms, taking into account the need to protect the environment and human health. In the same year, world leaders met at the UN headquarters in New York to adopt the Millennium Declaration. In it, nations committed to achieving, in 15 years, eight goals known as the Millennium Development Goals (MD Gs): Poverty reduction; Achieve universal basic education; Equality between the sexes and the autonomy of women; Reduce child mortality; Improve maternal health; Combat the immunodeficiency virus (HIV)/Acquired Immunodeficiency Syndrome (AIDS), malaria and other diseases; Ensure environmental sustainability; Establish a global partnership for development. 2002 – Rio +10 – Johannesburg – The World Summit on Sustainable Development took place in Johannesburg, South Africa, in 2002 and was known as Rio+10 because its main theme was the discussion about the progress achieved by some agreements created at Rio 92. At this meeting, two documents were developed: the Johannesburg Declaration and the Plan of Implementation. While the first reaffirms the commitments made in 1992, the second establishes some actions that sought to guide the implementation of such commitments; 2010–Nagoya Protocoland Aichi Targets–The Nagoya Protocolisa international agreement that regulates access to genetic resources and benefit sharing of biodiversity, adopted during the 10 th Conference of the Parties to the Convention on Biological Diversity (COP 10/CBD), which took place in Japan, in 2010. On that occasion, the Aichi targets were also created, which outline 20 objectives aimed at the conservation of Biodiversity; 2012 – Rio +20 – The third edition of the World Summit on Development Sustainable returned to its place of origin, in 2012, and again proposed the renewal of nations' commitment to sustainable development; 2015–Launchofthe SD Gsand the Paris Agreement–After the 15 years given by the UN to achieve the MD Gs, new goals were set for everyone countries implement them by the year 2030. This time, 17 goals were set

in the new sustainable development agenda. Also in 2015, it was signed the historic Paris Agreement, approved by 195 countries, to reduce the emission of gases that cause the green house effect, in an attempt to maintain the global temperature closer to pre-industrial levels (SOURCE: A Allonda Ambiental and the sustainable development.

TYPES OF ECONOMIC POPULATION

In the current era, the development and preservation of urban green spaces face significant challenges. That is, the maintenance of biodiversity and ecosystem services is a primary concern that must be recognized. Despite the perception that they do not offer economic value, the value of these services cannot be disregarded, as they are not considered human activities. However, it is particularly wrong to assume this, as these efforts assisting economic expansion and efficiency indifferent sectors, despite their lack of recognition. Evaluate the cost of these services, as it clarifies the funds needed to ensure the sustainable extraction of the resources needed for efficient maintenance and conservation. To properly manage natural resources, it becomes essential to consider their goods and services as commodities that require regulation careful. For this purpose, economic factors must be taken into account in decision-making. There are several methods of internalizing these services that can take into account the use value, the non-use value or the liability value. Use values derive from contact direct between people and the ecosystem, while non-use values do not require such contact. Figure 13 demonstrates the types of economic valuation based on physical and non- use of environmental services.

Figure 13–Types of economic valuation based on the physical and non-use of environmental services.
Source: adapted from Edwards and Abivardi (1989).

To measure the value of resources, it is possible to use the maximum amount of payment that people are willing to pay to increase their level of service or the compensation minimum they are willing to accept if their level of service decreases. The values of these measures can be based on revealed preferences and stated preferences. The preferences expressed indirectly, explained in terms of revealed preferences, discuss the value of a good, while stated preferences use answers obtained from hypothetical questions.
One of the commonly used, but controversial, passive valuation methods is the method of contingent valuation. In this way, people are asked directly how much they would pay for a service that could be provided or improved, or how much money they would accept as compensation for the loss of an environmental asset. The hypothetical market generated by the use of contingent valuation methods reproduces real markets where transactions occur with based on approximate changes in well-being in the real world. For any specific policy or action to be effectively implemented, the individuals must express their commitment to contribute as much as they are able. A technique was first used through face-to-face surveys to estimate the value economic of natural resources and began to gain recognition after the work of Carson (2001).

CHAPTER VIII

ASPECTS OF THE NATURAL AND ECONOMIC SPACE OF THE AREA UNDER STUDY GENERAL GEOLOGY

The Jardimdo Seridó Sheet region is located in the Borborema Province, in the Northeast of Brazil. The area is divided into three main parts by the shear zones of Pernambuco and Patos: South, Centerand North. This Sheet is located in the North region, separated by the NE-SW shear zone into four folded zones: Seridó Zone, Jaguaribeana Zone, Center of Ceará and North west of Ceará. In this region of the Jardimdo Seridó Sheet covers the regions north of the states of Rio Grande do Norteand Paraíba, specifically the region of Rio Grande do Norte or Seridó Sheet. Through Figure 14, one can see the geological configuration of the state of Rio Grande do Norte, with emphasis on the Pegmatitic Province of the area under study.

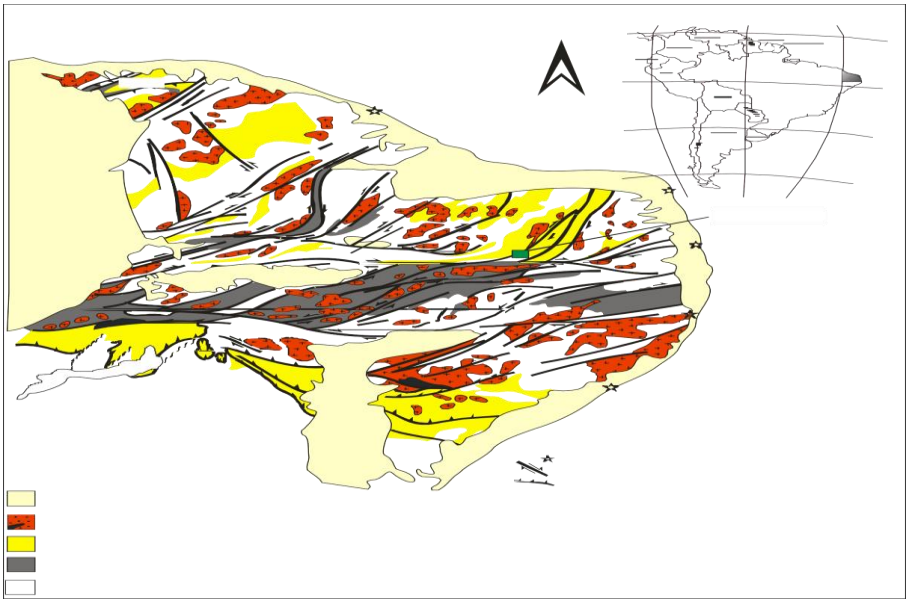

Figure 14 –Geological map of the state of Rio Grande do Norte.
Source: Mineral Resources Research Company (CPRM)/Geological Survey of Brazil.

The area is located on the Jardimdo Seridó Sheet (RN-PB) and is composed of three geological units. The rocks of the Paleoproterozoic basement, known as Caicó Complex,

consist mainly of ortho-derived rocks and banded gneisses that were strongly deformed and migmatized during the Transamazonian orogeny and subsequently extensively altered by the Brazilian orogeny. On to pofthis base is the Seridó Group composed of sedimentary rocks formed in the Neoproterozoic era that also were affected by tectonic processes during the Brasiliano event. Occasionally, these three formations overlap. In ascending order, the three formations present in the Seridó region are known as the Equador Formation, the Jucurutu Formation Jucurutu Formation and, finally, the Seridó Formation. The city that gives its name to these formations has mainly muscovite quartzites and polymictic conglomerates belonging to the Formation Equador. The Jucurutu Formation consists of gneisses, biotites, marbles, and amphibole sand ferruginous formations, while the Seridó Formation typically includes schists and biotites rich in feldspar and garnet. Cordierite is also commonly found here with sillimanite and andalusite. The schis to biotite is of the felds pathic variety found in the north western region of the Cruzetasynform, which is located in the core of geological formations. It is a schis trock green with layers of chlorite, muscovite and biotite. These strata are consistently observed as reliable indicators of their initial sedimentary structures. In addition, cross-stratification becomes a distinctive trait distinctive recognized through the quartzites in the Equador Formation. The southern part of this area is composed of Cenozoic classic sediments, and this is the third section of the geology. In its form and relief, it can be described as allow plain or a plateau deposited unconformably on Precambrian rocks.

GEOMORPHOLOGICAL ASPECTS

According to the Mineral Resources Research Company (CPRM)/Service Report Geological Surveyof Brazil(2007). The Jardimdo Seridó Sheet (SB.24-Z-B-V), scale 1:100,000, covers an area of approximately 3,000 km and is located in the extreme southern portion of the meso- Central region of the state of Rio Grande do Norte and the extreme Central-Northern portion of the State of Paraíba (Figure 15).

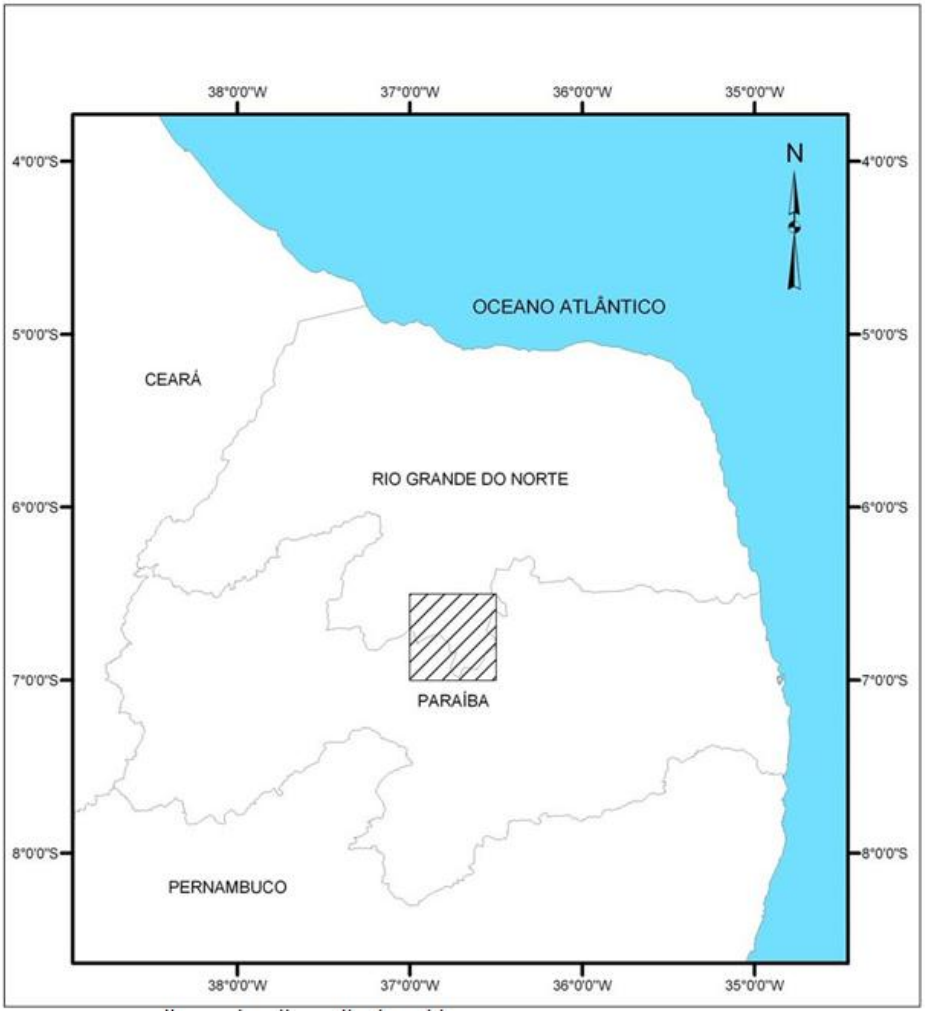

Figure 15–Location of the Jardimdo Seridó Sheet.

Source: Mineral Resources Research Company-CPRM/Geological Survey of Brazil.

Its coding within the International Maptothe Millionth (CIM) system and its limits are shown bellowing Figure 16. This are a partially encompasses the municipalities of Caicó (RN), São José do Seridó (RN), Acari (RN), Carnaúba dos Dantas (RN) Frei Martinho (PB), Picuí (PB), Ouro Branco (RN), Nova Palmeira (PB), Pedra Lavrada (PB), Várzea (PB), Santa Luzia(PB), Juazeirinho(PB), Seridó(PB), São Mamede(PB)and Juncodo Seridó(PB), and fully the municipalities of Jardim do Seridó (RN), Parelhas (RN), Santana do Seridó (RN), São Josédo Sabugi(PB)and Equador(RN), with the headquarters of some of these municipalities located within the sheet. Access from the northern part of the sheet is approximately 237 km from the city of Natal, being made via BR-226 and BR

427 and RN 086. The main roads that connect the headquarters of the afore mentioned municipalities are paved with asphalt and the others are graveled, but passable. The Jardimdo Seridó Sheet map is one of the maps included in the Geomorphological Sheet of Jardimdo Seridó, published by the Super intendance for the Development of the Northeast (SUDENE), illustrates the geomorphological properties found in the sector of the Massifs Crystal line of the Borborema Plateau, which extends through the Center-South of Rio Grande do Norte and Central-Northof Paraíba. Based on a methodology that uses topographic data, satellite images and field work, it was subdivided into several domains and units morphological with altitude range from 200 to 800 meters. Figure 16 shows us information about the municipalities represented in the Jardim do Seridó Chart.

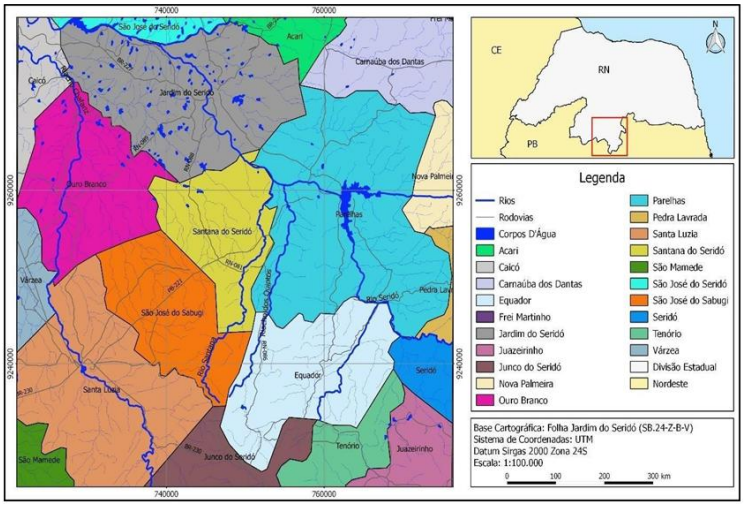

Figure 16–Jardimdo Seridó Chart.

Source: own authorship from CPRM (2009).

Most of the area of the region is occupied by pre-Cambrian rocks, which cover approximately 65%ofthetotalarea, while the remainder is covered by sedimentary rocks of the Meso-Cenozoicera. The Jaguar be domain extends from west to center through the Riodo main Piranhas Seridó, and the São Josédo Campestre domain marks the eastern zone of Brazil. Two large Brazilians hear zones–Portalegre to the west and the Picuíshear zone– João Câmara to the east – delimit these domains. The coding represented by this

Sheet is inserted within the CI Msystemandits limits are shown in Figure 17.

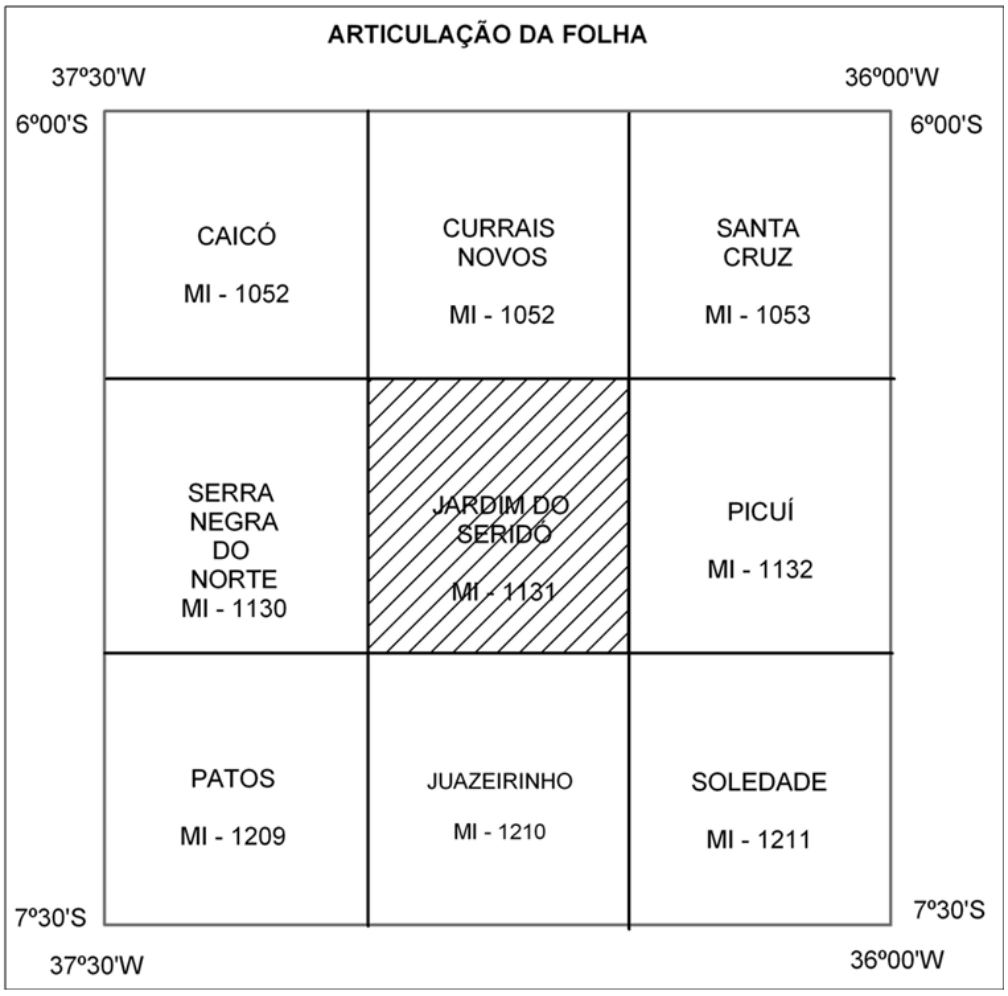

Figure 17–Articulation of the Jardimdo Seridó Sheet.

Source: Mineral Resources Research Company-CPRM/Geological Survey of Brazil.

The political and administrative boundaries of certain areas are ignored when considering the different land forms of the Seridó Potiguar. This happens because there are no standards geological for national administrative divisions. Geographically, the Seridó Potiguar, eastern portion, is located in the Borborema province, in the territory of Rio Piranhas Seridó. The Quaternary cover includes flood plains such as the Piranhas-Assú flood plain of the Seridó. These areas were formed by the latest fluvial deposits of sandy sediments from the Piran has and Seridó rivers, at an altitude between 30 and 200 meters. The Quaternary cover geological and environmental of the Seridó Potiguar flood plain, located in the semi-arid region of Rio Grande do Norte, plays a fundamental role in

understanding the natural dynamics, in the resource management and socio-environmental sustainability of the region. Below, I highlight its importance in different dimensions. This Quaternary cover, whose period covers the last 2.6 million years, preserves sediments and soils that tell the recent geological and climatic history of the region. Sediments transported by intermittent rivers (e. g. Seridó River) reveal periods of greater humidity in the past, contrasting with the current semi-arid climate. The pale sols to which refers to the layers of ancients oils, indicate environmental changes, such as cycles of desertification and vegetation recovery. Indicators of tectonic activity, taking into account deformations in sedimentary strata, point to crustal movements that influenced regional drainage. Studies in Quaternary sediments in Seridó suggest that the region once had courses more perennial water, with implications for the paleo-environmental reconstruction of the Northeast Brazilian. Through Figure 18, it is possible to perceive the morph structural diversification of the point of geomorphological view of Seridó Potiguar.

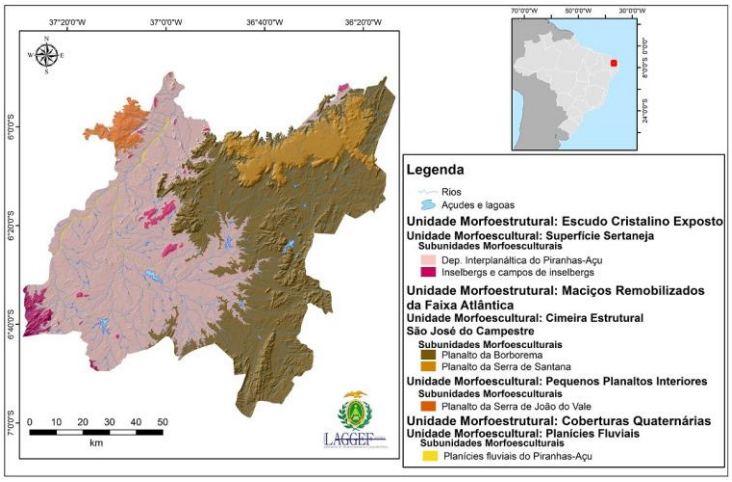

Figure 18 – Morphostructural and morphosculptural units of Seridó Potiguar.
Source: Oliveira et al. (2016).

ECONOMIC GEOLOGY

In the 1940 s, the state of Rio Grande do Norte gained prominence as one of the main producers of the Brazilian mineral industry. It is a pioneer in the production of gypsum and also, with sheltie concentrate and sea salt, it became the largest producer of both resources in the country. In addition, Rio Grande do Norte is an important source of primary kaolin and beryl concentrate in the Northeast region. The state is well served with mineral resources; this led to the discovery of numerous deposits, rock formations and mines rich in various minerals. Many of these areas are now part of operating mines or extraction systems. extraction. A state that has gained a national reputation for excellence in some areas minerals is Rio Grande do Norte. It is the largest producer of sea salt, the second supplier of oil (it is the first onshore) and the fourth largest producer of gas. In addition, it occupies a position of leadership in the Northeast of Brazil as the main manufacturer of bricks and tiles with important participation of feldspar, kaolin, mica, limestone minerals and precious stones such as water- marine or tourmaline. These achieve ments allowed Rio Grande do Norte to be declared the fourth region with the highest mineral production in Brazil.

Firstly, the mineral inventory comprises a total of 1993 locations where mineral deposits such as mines and quarries have been reported. These include more than 30 minerals, most of which occur in the Rio Piranhas Basin and the highest concentration in the locality of São Josédo Campestre. The age of these deposits is related to the layers sedimentary rocks from the Cretaceous and Cenozoic periods. The Jardim do Seridó Sheet is a region of the Brazilian Northeast known for its abundance of minerals and falls within the so-called “Borborema Pegmatitic Province”. Hundreds of deposits and occurrences have been discovered of ornamental rocks, metals, industrial minerals and precious stones and are associated with a variety of pegmatite’s and geological units in this area. Among the most common quartzes rocks with such minerals are conglomerates metamorphic rocks, par gneisses and mica schist’s present in various geological formations. According to information from the National Department of Mineral Production (DNPM, 2005), were 621 mineral records were discovered in the area. The most common substances include beryl (117 occurrences), tantalite (196 occurrences),

columbite (49 occurrences), kaolin (19 occurrences), feldspar (5 occurrences), mica (4 occurrences), corundum (2 locations), tourmaline (2 occurrences), barite(27 places), asbestos(2 places), talc(1 place), bismuth(2 places), copper minerals (4 places), fluorite(3 places), iron minerals(3 places), marble(29 places), stones ornamental (14 locations), uranium minerals(1 location), vermiculite(2 locations) and scheelite(139 locations).

The data initially collected are typically obtained from several samples of geological maps, and then these data must be augmented by including some other substances that can be found as secondary minerals, such as beryl, tantalite and columbite. This data set is considered for the determination of six mining regions based on their geological and geographical conditions and scale of production. The divisions in this case were defined as follows: Pegmatite sand Gemstone Minerals, Rocks Ornamental, Industrial Minerals, Metallic Minerals, Claysand Carbonates. Regarding their economic importance, pegmatites are types of rocks that harbor commercially important minerals such as feldspar, mica, kaolin (derived from feldspar), columbite-tantalite (Nb and Ta ores), beryl (used in industry) and gem varieties of aquamarine, (blueberyl) and colored tourmaline (afriscite and elbaite), in addition to lithium minerals and rarely euclase. Kaolin is a white, brittle, heat-resistant clay-type or that develops through weathering processes in hot and humid climates. Heat that develops through weathering processes in hot and humid climates. Kaolin mineral raw material issued in various branches of industry, including ceramics, white paints, paper, rubber, plastics, textiles; pesticides; fertilizers; adhesives; nail polishes; chemicals; leather. It is mainly composed of layers alternating of silicate kaolinite and smaller amounts of halloysite, dickite and nacrite. In the region known as the Pegmatitic Province, the pegmatites hosted in quartzite of the Ecuador Formation harbor abundant kaolin deposits with remarkably high concentrations high. There are a total of 17 separate bodies in these pegmatites, most of which are located around Parelhas and Equador, in Rio Grande do Norte, while Junco do Seridó and Juazeirinho, in Paraíba, have their own isolated bodies. The areas within these pegmatites that produce kaolin can be divided into two main zones: zone II is more frequent and impure, consisting mostly of mica and quartz, while zone III is mainly composed of homogeneous masses, bands or pockets. These caves are formed by erosion and can be up to 20 meters thick and run for hundreds of meters.

The mining works are done by the conventional method and the depths can reach 30 meters. Some scholars have found that, in the natural world, kaolin is made of kaolinite that forms layers; however, it may contain parts of tubular hallo site and other impurities, such as feldspar, muscovite and quartz. For example, in the research carried out by Bezerra and Nesi(1999), chemical analyzes and technological tests were carried out with samples of kaolin from Ecuador and the Carnaúbados Dantas region in the state of Rio Grande do Norte, which had low levels of Fe 2 O 3.

Kaolin processing normally involves rudimentary initial decantations or mineralized, which are a cleaning process where feldspar, quartz, grains are removed of mica and other impurities. Then, the suspension is sedimented by size in the range of mesh below 100 and 200 in settling tanks. Subsequently, the kaolin is air-dried and in an oven before being crushed into fine particles that are packaged and marketed mainly locally for use in ceramics, paints, paper, plastics and rubber. Tantalite and Columbite are minerals belonging to a group of isomorphic minerals that have the chemical formula (Fe, Mn) (Ta, Nb) 2 O 6, but have separate names due to the substitution of niobium and tantalum. These minerals occur in pegmatites in the region of Borborema do Seridó. Tantalite has a density of 7.0 g/cm³, while columbite has density of 5.5 g/cm³, in addition to high melting points and corrosion resistance. In these pegmatites there may also be pyrochlore, microlite, samarskite, loparite and others. The beginning of the exploration of tentalum and niobium minerals for atomic energy may be considered one of the most important steps in the development of its industrial use, since during the Second World War they were used in several nuclear reactors, capacitors, rockets and air planes. However, since 2001, the consumption of tantalates has decreased, which led to increased levels of existences and decreased prices. The main occurrences of tantalite mineralization occur mainly in pegmatites and are confined to the eastern and northeastern parts of the province. Other mineralizations were recognized along the mica schist of the Seridó Formation. In addition, manganese- and aluminum-rich tantalite varieties were also recognized, along with other minerals such as microlite and amarskite. Tantalite and columbite found in the Folha region, in Brazil, are also of different types, such as mangano tantalite and calogerasite, which take the form of deep red crystals. These minerals are widely used in the production of electronics, in the manufacture of

automobiles and in other technologies. According to research carried out, there are 281 pegmatites containing tantalates and niobates were found in the pegmatitic region of Seridó during the year 1989. Of these, the majority belonged to Ecuador (19), Parelhas (110), Jardimdo Seridó (118) and Carnaúbados Dantas (34)(XAVIE Retal.,2004). In the Seridó region, in the Borborema Seridó Province, one of the formations arose geological division known as the Ecuador Geological Formation and consisting of rocks quartzitic. These rocks harbor important pockets of pegmatites, which are reserves highly valuable minerals. There are two main groups of granitic pegmatites thatcan be separated into homogeneous and heterogeneous. There are also mixed pegmatites, but not as many compared to the belonging to the previous groups. The Borborema Seridó pegmatitic province is one of the several pegmatitic provinces that include the areas (DASILVA; DANTAS,1984). Our research identifies this area of the Seridó zone, and belongs to the Rio Piranhas Seridóarea. The region is on the borders of the states of Rio Grande do Norte and Paraíba, in Seridó. In other regions of Rio Grande do Norte, there are some other examples, but smaller, such as Tenente Ananias and Lajes Pintadas/São Tomé, which have some unique characteristics located in an extremely narrow basement be low the Rio Piranhas. Pegmatite deposits are currently an important source of some minerals vital to meet the demands of today's society. For example, colored gemstones such as aquamarines and colored tourmalines (elbaite) are highly valued in these deposits and constitute the luxury market, among others. In addition, the same deposits also produce minerals used in industries such as feldspar, kaolin, quartz and mica. Other non-ferrous metallic or sounding pegmatites are beryl, columbite-tantalite, cassiterite, spodumene and amblygonite. Rio Grande do Norte is a place that stands out for the enormous amount of different types of beautiful and high quality gemstones. Based on Moraes (1999), there are 11 main gems: aquamarine, colored tourmaline (elbaite), emerald, amethyst, lazurite, garnet (spessartine variety), corundum (sapphire variety), rosequartz, euclase, cordierite (iolite) and collectible beryl. He also identified the three main regions where these gemstones can be found, called the Centro-Sul, Sul and Extremo Sudoeste gemological districts. The southern gemological district includes the cities of Parelhas and Equador, where they are found precious and lively tourmalines, multicolored gemological elbaites that are highly sought after throughout the world. This area is an interesting illustration of

the rich mineral potential of Rio Grande do North. The formation of the deposit occurs in highly evolved pegmatitic and differentiated in various ways. In this region, mining is carried out in two ways: by companies or at a personal level through mining activities. In the South of Rio Grande do Norte there is a gemological district that includes the cities of Parelhas and Equador, known for its beautiful tourmalines and elbaite stones. These stones have their place in trade international and also indicate how rich the place is in gems. Mineralization occurs in heterogeneous, strongly crystallized and pegmatitic veins, segregated. There are two types of mining: those in which companies carry out extraction operations and also mining activities carried out at the domestic level. The exporting industry of the mining sectors facing a serious challenge that has led to the enormous evasion of raw and processed gems from the state and, as a result, the losses incurred in Rio Grande do Norte are immense, while tax revenues have also fallen to low levels.

The kaolin deposit can be classified into three main categories: pegmatitic, sedimentary, as well as surface alteration (NESI; CARVALHO,1999). Pegmatite deposits are generally considered economically significant. Different authors have mentioned about 47 kaolin-containing pegmatite bodies; more notably in the municipality of Ecuador, followed by the municipality of Parel has and the municipalities of Carnaúbados Dantasand Acari. In these deposits, the view prevails that kaolin is a final product of the transformation of feldspars into other minerals. In the field, homogeneous and heterogeneous forms of pegmatites were discovered kaolinized. The former are much larger, more diverse, better understood and contain three types of specific kaolin deposits in such formations. The salt type is by far the most frequent occurrence, characterized by a whitish granular aggregate, where impurities are not rarely associated with kaolin, such as mica and quartz. The second type is vein kaolin or fatty type; consists of high levels of kaolin concentration and can be seen as separate spots in a soft paste and homogeneous, without visible impurities. The third variety, dry, is only starting the phase of feldspar alteration. Mineralogically speaking, kaolins are made up of kaolinite well-developed hexagonal, mainly lamellar, sometime seuhedral, in quantities varied. The presence of hallo site is uncommon and gibbsite is completely absent; in addition to a small percentage of traces, feldspar, quartz and muscovite also occur as minor constituents, usually with very fine grains.

The proportion of Fe 2 O 3 and Ti O 2 that kaolin has is one of the factors that determine its color and whiteness. These oxides are usually in very small quantities and range from 1.2%, 0.5%to 1.7%. Such levels are considered acceptable to achieve whiteness International Organization for Standardization (ISO — International Organization for Standardization) high desired (>85%) characteristic of kaolin. Although raw kaolin, obtained in the mines, which contains impurities in its natural form, does not meet the standards of the market, it must be subject to further processing. The municipality of Ecuador has the largest official kaolin reserves.

PHYSIOGRAPHIC ASPECTS

The Jardimdo Seridó Sheet is located in the semi-arid northeastern backlands. This region has a hot and dry climate with minimal rainfall throughout the year. Rainfall is more common between March and June. The temperature ranges between 25°Cand 35°C, with an annual average of 28°C. The intermittent rivers in the region mainly flow in three directions: Northwest, Northeast, and East- West. The predominant vegetation is caatinga, composed of shrubs and cacti such as piqué, facheiro, and mandacaru. The relief in the Jardimdo Seridó Sheet area is determined by the type of rock that predominates there. The altitude varies from 200 to 800 m with vast plains and mountains that extend from North to Northeast; in addition, there are many high points in the entire region. Located in Northeast Brazil, the study area is one of the most significant tectonic features. It is divided into three main sections, namely the South, Central, and North parts, separated by the East-West shear zones of Pernambuco and Patos. The current sheet that we are considering divides a region into four different land formations or folding domains, also delimited by shear zones, but this time in the Northeast-Southwest orientation with the East-Westflowcalled Serrado Seridó, Serra Jaguaribeana, Centraldo Ceará(ordomain), and Serrado CearáNoroeste. Locatedinthe Rio Grandedo Norte Domainregion; which spreads through parts of the states of Rio Grande do Norte and Paraíba; this location represents the Northeast part of the North Domain called the Seridó Belt or Rio Grande do Norte Domain; among which is the Jardimdo Seridó Sheet. In the Seridó Belt region, there are different types of rocks, among the mare: (i) Archean and

Paleoproterozoic gneisses or migmatitic basement rocks; (ii) a sequence of rocks supracrustal deformed developed mainly in the Neoproterozoic; and (iii) granitic intrusions cut by the deformed rocks of the upper crust.

In addition, Mesozoic and Cenozoic sedimentary sequences canals obey found covering some parts of the area. The geographical features that can be observed in the region developed as a result of the interaction between the plutons and the host rocks. The main orogenic event in this area that affected the state and the entire region is known as the Brasiliano Cycle, which resulted in the development of folded and metamorphosed topography, tectonic structure, and fragmentation of the Modern Seridó Belt. Certain other significant faults and shear zones that limit this region areal so considered products of the Brazilian Cycle, some of which are faults that extend to the Earth's mantle or separate distinct tectonic blocks. The fragile structures of fractures and joints that are found in the crystalline terrain described above developed after we at herring processes began to erode these elements, probably during the Upper Neoproterozoic, or possibly when Africa and South America were separating (SZATMAR Ietal.,1987).

The Equador Formation is a combination of the Jucurutu Formation where layers upon layers consist of muscovite quartzite, while some are pure feldspar accompanied by tourmaline. The layers generally exhibit a color banding pattern such as gray, pink, green or beige, occasionally with evident layers. On the other hand, meta conglomerates in certain variable interbedded or lenticular facies also occur within this rock unit. The Metasupracrustal Formation is a rock unit within the vast group of pure quartzites, muscovite quartzites and Archean muscovite quartzites highly developed in the Serra das Queimadas. The most common variety of quartzite muscovite has its grain size varying from fine to medium and light gray color. Typically contains about 80% quartz, 15% muscovite along with some accessory minerals, including hematite, feldspar, tourmaline and fuchsite, among others. In the study by Valadãoetal the Thornth waite and Mathermodelare investigated for the Seridó/RN region, with Equador in a mesothermal climatic area semi-arid with zero or very low water surplus, belonging to type Dd B’2 a’, due to low level of rainfall experienced throughout the year, except Currais Novos, falls in the semi-arid. Similarly, they captured information from the Agricultural Research Company of Rio Grandedo Norte (EMPARN) based on monthly precipitation data for

this region which was about 400 millimeters annually, indicating that it had the lowest precipitation rate in the its micro region. The rainy season occurs between February and June, where the average temperature varies between 33.0°Cand 21.0°C(CPRM,2005).

CHAPTER IX

THE CAATING A BIOME AND THE SCENIC BEAUTY OF THE LANDSCAPES

The natural environment of the caating are presents 11% of Brazil's land area and 70% of the Northeast region. It covers the states of Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Piauí, Alagoas, Sergipe, Bahia and Minas Gerais. The caatinga covers an area of 826,411 km and is an important ecosystem of unique biodiversity in Brazil. According to Figure 19, it is clear that the Caatinga Biome dominates most of the Northeast region, as well as parts of the North of Minas Gerais, including the Jequitinhonha Valley region.

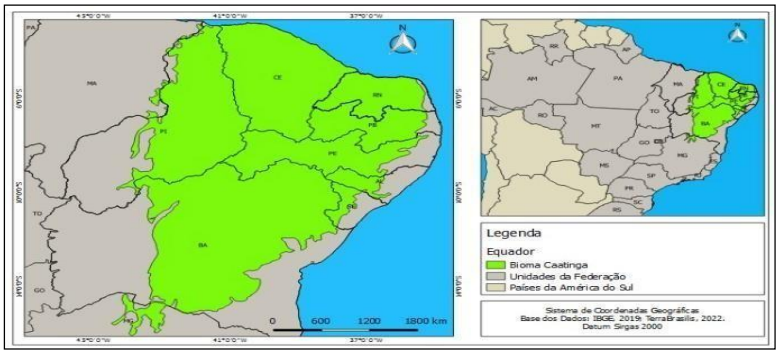

Figure 19–Location of the Caatinga Biome.
Source: author's own from IBGE (2020).

Based on the mapping of the Brazilian Agricultural Research Corporation (EMBRAPA), using Figure 19, the Caatinga Biome can be distinctly recognized. The limits of the semi-arid regions in this map were defined in relation to the political administrative divisions, permanent water bodies and altitudes. Its area of occurrence is almost coincident with the current limit of the Brazilian Semi-Arid region, with the caatinga also occurring in the western and northern portion of the State of Piauí, North of Ceará and in part of the

eastern coast of the Region Northeast (Figure 20), corresponding to the political and geographical borders of the semi-arid region, according to EMBRAPA.

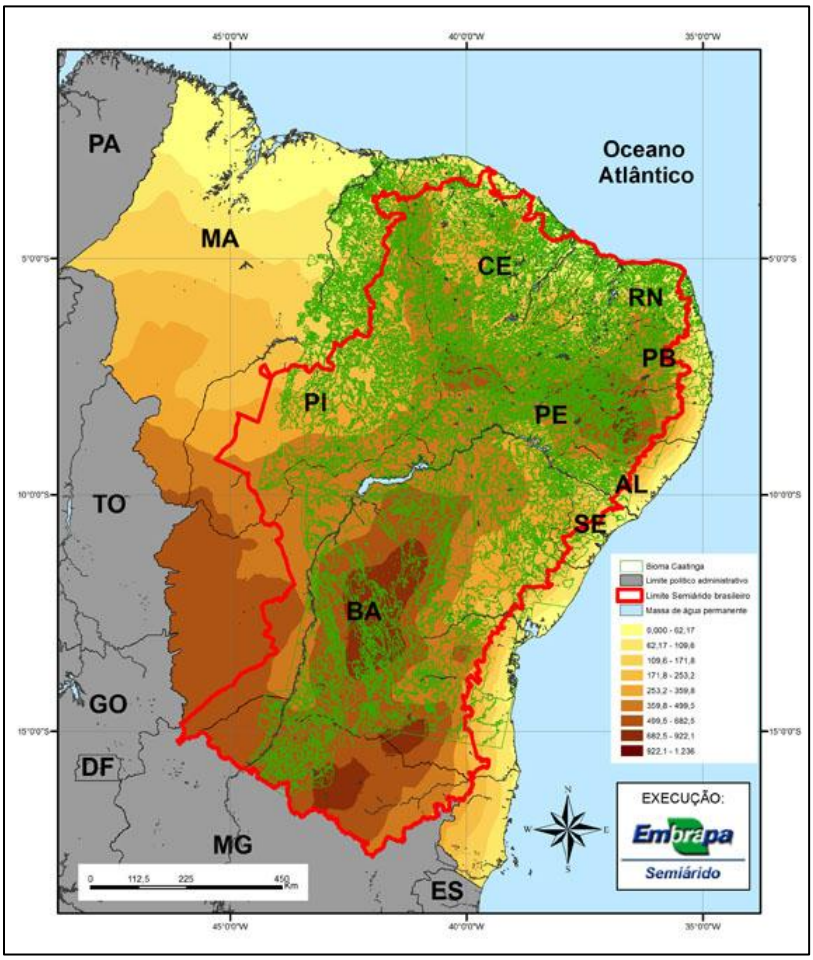

Figure 20–Political and geographical borders of the Brazilian Semi-Arid region.
Source: Geo processing Laboratory Embrapa Semi-Arid.

The Caatinga region is one of the ecosystems most influenced by human activity in Brazil, and 45.3% of its area has already changed. This makes it the third most affected biome in the country, behind of the Atlantic Forest and Cerrado. On the other hand, it is also a less preserved biome, with only 8% of the protected area of 123 conservation units (CU), 41 of which are completely protected and 82 are used in a sustainable manner. The most beautiful landscapes of this biome are composed of a variety of xerophytic plant formations, types of rocks, variations in altitude and soil. In addition, there are some prehistoric images found in some places in the Serra da Capivara in the state of Piauí, one

of the most significant places. Scientific investigations provide evidence of the fact that people settled in this region 32,000 years ago. With all that has been said before, the Biome Caatinga is shown in Photo 3.

Photo 3–View of the landscape of the Brazilian caatinga.
Source: Lauretti (2019).

The Seridó Geopark, according to the Brazilian Geoparkin 2022, received this title in the same year. It covers the total area of six municipalities in this region. The biodiversity of the Geopark is impressive and this recognition was received in April 2022 at the 214 th session of the UNESCO Executive Council, winning the UNESCO World Geopark Seal. To discuss the beauty of Seridó, it can be said that there are Rocky Mountains, paths, rivers, lakes and forest systems; Archeology also exists with its cave paintings and inscriptions of caves as tourist centers that make it special. The Seridó Geopark and the six municipalities that integrate it in the Central-South region of Rio Grande do Norte are presented in Figure 21, below.

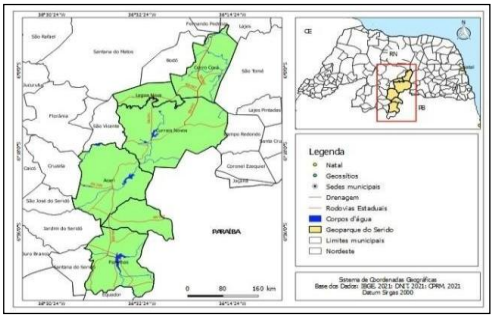

Figure 21–Location of the Seridó Geopark.
Source: Nascimento (2021).

A variety of geological features found in the Seridó region makes it an ideal location for the creation of a geopark. This is due to its remarkable natural heritage which comprises numerous geological formations that reflect the peculiarities of the region. The result is represented by characteristics such as relief and landscape. In addition, the geology local has a significant cultural value that supported the creation of the geopark in combination with archaeological, tourist and scientific benefits.

CHAPTER X

A MOSAIC MODEL APPLIED TO THE CAATINGA BIOME OF SERIDÓ POTIGUAR

The mosaic, which is a holistic and innovative approach to conservation management, serves as an effective too linage guarding both Pas and protected areas. Furthermore, it is worth mentioning that one of the reasons that contribute to the decrease in diversity biological worldwide is related to deforestation or loss of native vegetation due to human activity. PAs play a fundamental role in biodiversity conservation; its creation is one of the most important measures. The use of the mosaic model allows promote participation and socialization in the management of biodiversity and geo diversity in the scope of the SNUC. The objective of this chapter is to explore the potential effectiveness of proper management of the mosaic in PAs for the conservation of biodiversity and geo diversity using the Caatinga Biome in Seridó, Rio Grande do Norte as a case study. To emphasize how significant the losses and damages incurred due to processes are of unregulated conversion in natural habitats, due consideration should be given to an environmental study on the implementation of measures in protected areas. Although they already have been carried out experiences with mosaic management practices and ecological corridors in the Brazil, these systems require organization, systematization and planning to be able to meet their objectives. In this project, many factors that must be considered are biophysical, socio economic and political-environmental. The study is directed towards the creation of a system of mosaic, which can be taken as a tool for conservation, integrating the level bioregional conservation in the socio cultural and political-economic

dimensions. In the case of Caatinga Biome, it is recognized that its biodiversity is the most abundant variety on the planet; however, it is also vulnerable to a hostile environment resulting from many factors, such as human activity, particularly the extensive extraction of natural resources without control appropriate. One reason to save this biome is to prevent desertification. PAs cover only about 9% of the area, which is insufficient. The mosaic of PAs is a management approach in which the roles of managers and residents are synthesized in the with regard to diversity and other issues such as biodiversity, social diversity and sustainability. According to the SNUC Law, mixed councils must be created for management of the mosaics. Therefore, it is important to strengthen the conservation of existing CUs, as well as contribute to the preservation of nature. To ensure that a CU effectively contributes to conservation, one of the requirements is the creation of mosaics of areas, these being instituted as an operational concept of the protected areas system (DAVEY; PHILLIPS, 1998; BRAZIL,2000; PHILLIPS,2002; TO MÁS; MIDDLETON,2003; BENNETT; MULONGOY,
2006). Mosaic, according to the SNUC, is an area defined as a set of CUs with different management categories or not, spatially close, juxtaposed or overlapping, and its management must be coordinated to make them compatible with other processes in a context regional so that the region's biodiversity can be adequately conserved. In the scope of science, landscape science is seen as an essential tool that helps to identify priorities for conservation purposes and establish new areas that should be protected, while ensuring effective management strategies for existing areas (MILANO, 1990).

The concept of “landscape” is quite diverse in the literature and differs from author to author with different approaches in various aspects (BIONDI, 2005). Thus, the landscape could be represented as a complex and multi-level formation. The Brazilian landscapes illustrate the variety of functions that give rise to different scenarios and social conflicts between actors (BRITO, 2003). These types of zones are essential in environmental planning (POLETTE, 2003), as they are highly fragile areas that require preservation efforts and also as sets potential for human activities (SANTOS; CALDEYRO,2007). The Mosaic Modelisa holistic management approach that helps preserve CUs and Protected Areas. A significant reason behind the decline in global biodiversity is the destruction of vegetation native by man. Meanwhile, the formation of CUs stands out as

an important step to ensure biodiversity conservation. The mosaic model also finds application in encouraging participation and social management of biodiversity and geo diversity within the scope of the SNUC. The objective is to explore how conservation and preservation of biodiversity and geo diversity through the management of mosaics in CUs, using the Caatinga Biome in the Seridó region as a case study. To ascertain the reduction and destruction caused by uncontrolled modification of the habitat natural, it is essential to consider environmental surveys on the process of implementation in PAs. Despite efforts to evaluate mosaic management experiences and ecological corridors in Brazil, these mosaics require organization, systematization and planning to achieve their objectives. The main components of all these factors addressed in this project are biophysical, socioeconomic and political-environmental. This study seeks to formulate a concept of mosaic as a conservation tool that could combine socio cultural, political-economic aspects with environmental conservation on a scale of bioregion. The Caatinga Biome is home to the highest level of biodiversity on Earth, but is a victim of environmental deterioration caused by several factors, including human activities, such as uncontrolled exploitation of natural resources. One of the main reasons why this biome needs preservation is to hinder desertification. The protected area system is not extensive enough to serve conservation purposes; the units cover only about 9 % of the total extent of this ecosystem zone. The patch work of PAs as a scheme of management tries to combine the roles played by managers and residents, so to unite diversity and other factors, namely biodiversity, social diversity and sustainability into a single whole. According to the SNUC Law, mixed councils must be created for the management of mosaics. Therefore, it is important to consolidate the existing PAs and also ensure that they contribute to the preservation of nature. Earth science is a scientific field where the components of the landscape are understood as an important element for defining priorities of conservation, to identify new protected areas and to manage existing protected areas (MILANO, 1990). The notion of “landscape” incorporates a series of concepts elaborated by different scientists with emphasis on various aspects (BIONDI, 2005). Thus, a landscape is an area of variable composition containing two or more connected systems. The arrangement of a landscape is composed of three entities: matrix, fragments and corridors; these elements spatial merge into various arrangements forming

mosaics that vary the landscapes. For its time, these spatial patterns can have different components originating from the natural framework such as relief, litho logy, climate, soil, water, vegetation and fauna (FOR MAN, 1995; MARENZI, 2000). In addition, this great diversity of indicators mentioned above may result not only from human action as we consider where some artificial elements arise directly from human interference (BIONDI; LEAL,2002). Considering the spatial configurations of the landscape, there is an ongoing debate about how landscape ecology can be used as an approach in the development of conservation area plans that can help ensure the protection of biodiversity, determining the role of landscapes in ecological processes to understand the structure of the landscape formation (METZGER, 2003). The monitoring of protected areas can also be approached from a landscape perspective, where landscape analysis considers management plans and conservation strategies that conservation strategies that recognize that the mosaics of PAs should not be seen as unique, but in a PA approach. Hetero genetic, in general, is characterized by a area not being continuous and having a diversity of different ecosystems (LOVET Tetal. , 2005) and can be understood based on the type and arrangement of landscape elements, in the intensity of the interactions between these elements, and the nature of their relationship (MIMRA, 1993).

Similarly, different pressures on natural spots (TURNER; CARDILLE, 2007), matrix porosity (COUSON et al., 1999), or even connectivity between elements (LI; REYNOLDS,1995; MCGARIGAL; MARKS,1995) can be seen as causes of the same problem. Landscape complexity does not always equate to impacts. De Pablo (2000)

Pointed out that the structure of the landscape may or may not result in adverse effects depending on the relationships between its characteristics in varied types and quantities. In the environmental sphere Brazilian, there are questions about the potential limitations for a greater expansion of the System of Conservation Units (SUC) in only two or three decades, and it is necessary to trace way stop reserve this system on a large scale in other areas as well due to its increasing pressures. Certain strategies for dealing with these changes are identified from ecological and landscape management studies (FONSECA; PINTO,1997).

The present study related to this area aims to investigate the landscape matrix and the characteristics of the fragments, as well as their spatial functionality for PAs of the bioma

Seridó Potiguar. Integrated management is an example of this interdisciplinary field, which tries to reconcile scientific findings with political decisions that involve public participation. A creation of such mosaics is often fraught with problems, and its implementation can be only fictitious, without any tangible improvements in community life, similar to many PAs that were formulated but remain unimplemented (TAMBELLINI, 2007). The initiative that made Seridó Potiguar a candidate for a mosaic of PA is, therefore, an achievement. One of the objectives of this study is to show the idea of creation of a mosaic in the Seridó Potiguar biozone, in the state of Rio Grande do Norte, Brazil, with based on other similar studies on mosaics. Because there is not much research done in Brazil on its implementation, and this research will try to analyze how they can be created mosaics in areas that are under protection so that their effectiveness can be improved. This part of the caatinga is one of the largest unexplored areas remaining in the state of Rio Grande do Norte, which also suffers from widespread desertification. Initially, it was bibliographic data search and document analysis were carried out in various sources, including scientific articles, monographs, dissertations, official websites, legislation and decrees to subsidize the construction of the proposal for the UC Mosaico Seridó Potiguar of Rio Grande do Norte. The first stage of the study revisited how scarce the literature on the subject is; however, a brief review indicated that of the articles published, most dealt with issues such as organizational management (SILVA, 2021), legislation (MACHADO; COSTA; VILANI, 2012), mosaics Brazilians (MACIEL, 2007), ecosystems corridors (LINO; ALBUQUERQUE; DIAS, 2007) and UCs (BURKOWSKI; BOAS, 2014), but very few dealt with mosaic issues on UCs and protected areas in Brazil (CAMPOS, 2011; MELO; IRVING, 2014). The analysis of the landscape structure will be done with images collected from the satellite Map biomas, which will help to see where natural resources are spread throughout the region. Furthermore, in addition, information from the Brazilian Institute of Geography and Statistics will also be used (IBGE), through the Geoprocessing and Remote Sensing Division. In the hydrographic region of the Eastern Northeast Atlantic, there is a considerable number of small and medium-sized reservoirs that help in storing water for agricultural practices and human consumption. Among them is the Seridó River, which crosses the states of Rio Grande do Norte and Paraíba. It represents the main sub-basin of

the hydrographic basin Piranhas-Açu. The bordering areas are located between 6°02′and 6°58′ south latitude and 36°15′ to 37°17′ west longitude. There are 17 municipalities covered by its hydrographic basin. This river has its origin on the lower slopes of the Serra dos Cariris and Serra do Alagamar, in the jurisdiction of Cubati, Paraíba. Similarly, it is dammed further up stream in the municipality of Seridó, also in Paraíba, and for a long time served as municipal water supply for São Vicente do Seridó. That is, soon after the flood period, when it overflows from the dam, there are natural pools near the Serra Branca region, which is between the municipalities of Pedra Lavrada and Parelhas. On its way it flows in to the Rio Grande do Norte through the municipality of Parelhas, where it is obstructed and the Boqueirão Damis formed. After that, the riverbed cuts through the cities of Jardim do Seridó, São José do Seridó, Caicó and São Fernando and, in the latter, four leagues north of the city, the river mixes with the Piranhas River. Using Figure 22, one can visualize the Geomorphological Map of the Basin Hydrographic of the Seridó/PB River.

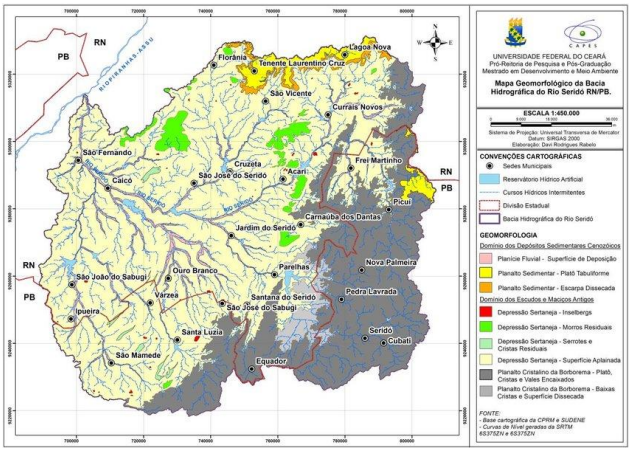

Figure 22 – Geomorphological Map – Seridó River Hydrographic Basin.
Source: Rabelo (2016).

DISCUSSIONS ABOUT THE PROPOSAL IN THE ELABORATION PROJECT OF THE SERIDÓ MOSAIC

There are PAs to protect natural resources, in valuable to multitudes around the world. In terms of ecosystem functioning, these areas are important because allow the genetic

diversity of biomes to evolve in response to pressures exerted by natural selection (MATOS; SERRA,2020). The conservation of natural areas has many advantages, and one of them is that it functions as are pository of bioactive substances that can be used in the production of new medicines that promote human health, diversity and genetic stability (GRISE, 2013). In addition, they provide shelter for endangered species and assist in carbon sink conservation, are major contributors to the production of clean air and water clean, serve cultural or sacred sites held in high esteem by people, in addition to supporting the survival of millions. A sustainable future cannot be achieved without areas protected (HONOR,2018; DUARTE,2012). However, it is also important that a method such as the Rapid Assessment and Prioritization of Protected Area Management/World Wildlife Fund Brazil (RAPPAM/WWFBR) be used to determine the effectiveness of the Potiguar PA System. To date, in the case of Rio Grande do Norte, where this system does not exist, there are many weaknesses that need to be eliminated, including insufficient investment in human and financial resources; the lack of investigation into the use of resources from a sustainability perspective and less social and political commitment to the conservation of a continuous system of protected areas. However, it can also address operational planning based on socioeconomic and environmental values as well as adequate physical infrastructure for PAs, successful communication between the management actors involved and community participation through councils (TEIXEIRA; VENTICINQUE 2014).

According to Burkowski and Boas (2014), habitat destruction and changes can be considered an inevitable aspect of human activity. The study proved that even an thropogenic biomes can effectively contribute to the conservation of some biosphere. On the other hand, comprehensive field investigation and its proper development should be an integral part of the theme, as well as the evolution of methods and techniques. The advisory councils of the Mosaic should also exist and act as a single governance institution for the PAs. In the Mata Atlântica Biosphere Reserve, a significant strategy for conservation was the establishment of ecological corridors and the creation of standards through PAs and protected areas; consequently, the PAs increase, solidify and form while their management systems depend on integration into the environment (LINO; ALBUQUERQUE; DIAS, 2007).

Commonly known as Law 9.985 of 2000 or SNUC Law, this is the legal basis that defines and guides the creation and management of PAs in Brazil with the main objective of instituting the National System of PAs. These PAs are created in accordance with this law. Territorial space and its environmental resources, including jurisdictional waters, with natural characteristics relevant, legally established by the Public Power, with conservation objectives and limits defined, under a special administration regime, to which adequate guarantees of protection apply (BRASIL,2000).

The establishment of SNU Clegislation has the advantage of bringing together in a single norm the majority of elements related to the establishment and operation of PAs in Brazil. However, there are some points that need to be considered despite this progress. Several territorial spaces, especially those essential protected areas to the efficient functioning of the system, were not accounted for in the SNUC, including territories indigenous and quilombola, legal reserves, Environmental Protection Areas(AP As), areas of special tourist interest, caves, among others (SCALCO; GONTIJO,2009).

Campos (2011) reports that discussions about environmental issues and the appeal for protection of specific areas reached its peak in various sectors of society. As a result, the use of resources is emphasized as a negative practice that should be controlled due to its continuous intensification. The application of this basis canal so help to provide details of some strategies on how sustainable resources can be managed. The author explores Tambellini's (2007) perspective on the link between governance environmental and territorial planning, as well as sustainable development. The writer suggests that a development project centered on a particular “place” or “region” introduces the concept of property and territorial use from a point of view alternative. Looking from this point of view, it is obvious that the number of people on the planet is increasing exponentially and causing great damage to the environment; therefore, a loss notable in biodiversity through the irreversible extinction of species due to the destruction of the habitat (CAMPOS, 2011). Therefore, the reasoned for immediate measures in the introduction of initiatives and schemes to mitigate these impacts and reduce environmental degradation; and the use of mosaics in PAs canal so be a suitable option. As can be seen in Figure 23, which shows the result of the land use analysis based on Map biomas data (2023), the mosaic of

vegetation and land use in this area remains mostly unexplored, with dense vegetation and sparse occupying a substantial portion while pasture areas are scarce.

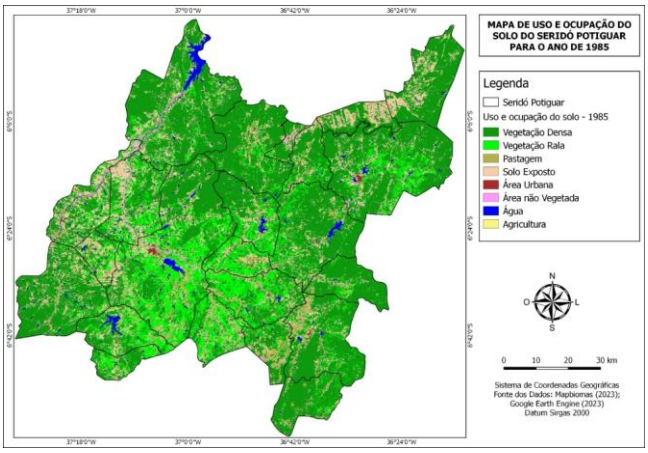

Figure 23–Land use and occupation map of Seridó Potiguar–1985. Source: Author based on Map biomas (2023).

After a period of about 15 years, agricultural activities intensified to the north of this region, mainly near Serrado Doutor, where the seraphic conditions are more conducive to the activities, noting that there is already a decrease in dense vegetation of the caatinga and a small increase in pastures, exposing the soil, with the introduction of small breeding farms. These changes can be seen in Figure 24, below.

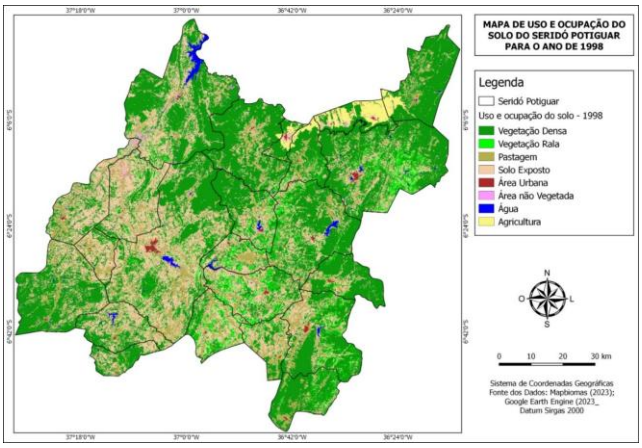

Figure 24–Land use and occupation map of Seridó Potiguar–1998.

Source: Author based on Map biomas (2023

After another 15 years, it is observed that this space already has significant changes significant, pointing to an increase in small agricultural and livestock activities, with a good part of its soil becoming bare, mainly due to the extraction of firewood to serve the ceramic activities and settling furnaces of kaolin, more specifically in the municipalities of Carnaúbados Dantas, Parelhas and Equador. The afore mentioned changes are well defined in Figure 25, below.

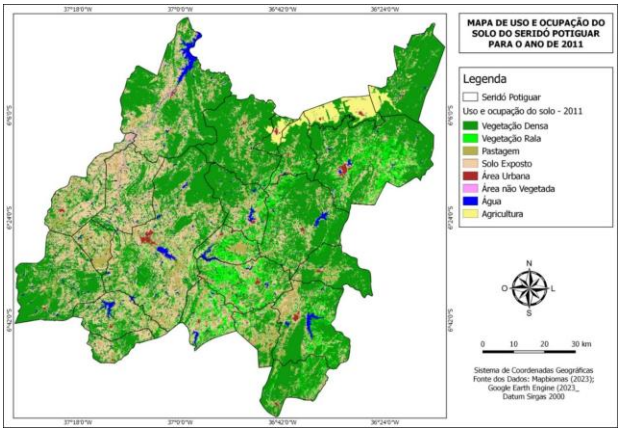

Figure 25–Land use and occupation map of Seridó Potiguar–2011.

Source: Author based on Map biomas (2023).

In 2021, this biome already has a significant alteration in almost all of its space, observing that, due to the agricultural and live stock expansion and intensification of mineral extraction activities, this fragile biome of the Caatinga of Seridó Potiguar has been suffering a significant impact on its natural environment, especially becoming an intense nucleus in the process of desertification before the UN. Figure 26 shows the evolution of land occupation in Seridó Potiguar in the period from 1980 to 2021.

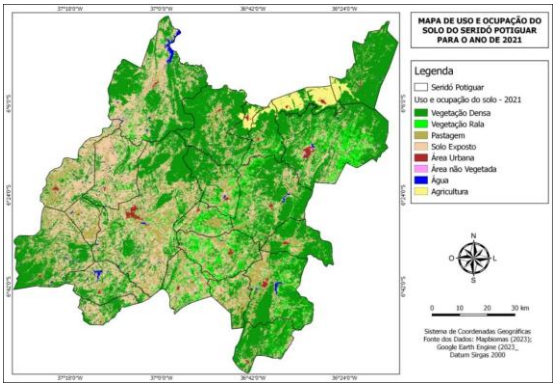

Figure 26–Land use and occupation map of SeridóPotiguar–2021.
Source: Author based on Map biomas (2023).

Rêgo (2012) attributes the beginning of discussions about desertification to three aspects. Firstly, the Frenchman Louis Lavaudeu would have, in 1927, reported in an article the impoverishment of the groves of southern Tunisia, stating that desertification was a process of anthropic origin. Another Frenchman, André Aubréville, would have, in 1949, in the book "Climats, Forêts et Desértification de l'Afrique tropicale", characterized the replacement of tropical forests and subtropical forests by savannas, understanding that the degradation process was the result of predatory use of resources. The third aspect credits the North American studies related to desertification, from degradation processes that occurred in the Midwest of that country, the origin of the debate on this topic. In this region, deforestation and the intensification of the exploitation of soils by agriculture and live stock, aggravated by a severed rought between 1929 and 1932, would have caused the phenomenon of dust storms known as the Dust Bowl. According to the Figure 27, the desertification centers of the Brazilian semi-arid region are observed, in which the Seridó Potiguar is inserted.

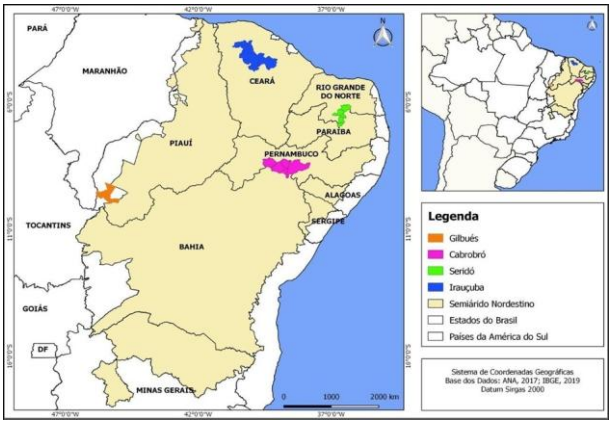

Figure 27–Desertification nucleu of the Brazilian Semi-Arid region.
Source: Silva (2017, p.31).

CHAPTER XI

IMPACTS AND ENVIRONMENTAL DEGRADATION TO THE DETRIMENT OF SCENIC BEAUTY

Environmental degradation is a term with a decidedly negative connotation. It has been shown that it is used in “modern scientific and popular environmental literature almost always linked to an artificial or human-caused change or disturbance – it is often a reduction in the natural conditions or state of a perceived environment” (JOHNSON et al., 1997, p. 583). The agent responsible for environmental degradation is always the human being: “natural processes do not degrade environments; they only bring about changes” (Idem, p. 584). Conversely, if the environment suffers a decline in quality or a reduction of its natural properties, it can be argued that degradation has occurred.

According to Brazilian legislation, degradation is defined as alterations that negatively affect the natural characteristics and values determined by the National Environmental Policy Law. However, not all situations fit this definition; some cases, such as socioeconomic activities, the biosphere, aesthetics, or hygiene conditions, must be identified under the same act as pollution.

Environmental quality is a term that provokes debate; it is a multidimensional concept that encompasses a set of qualities and characteristics of the environment, reflecting both the natural and built environmental systems, such as air quality, water quality, or the general or local level of pollution, in which not only human beings but also other organisms in that environment are affected. It denotes “the interrelationship between the needs of one or more species or humans, environmental conditions, and any objective or personal parameter.” Environmental quality should be expressed in terms of a set of objective indicators, which can only be understood from the perspective of different social actors (SACK, 1974).

From another perspective, environmental deterioration occurs when a harmful alteration happens in any process, function, or part of the system, eventually resulting in a reduction of quality. In short, environmental ruin refers to negatively affecting the environment. The term “degradation” may also refer to natural and cultural landscapes have been altered from their original state. The elements that deteriorate are mainly natural spaces, but also the built environment. In these sentences will be described some of the consequences of this condition for the environment. We must keep in mind that just as pollution can occur at various levels, the degradation is no different and can be observed to some extent. Although the level of disturbance may not be so great that it allows the ecosystem to regenerate on its own, beyond a certain level of degradation, spontaneous recovery does not occur or takes a long time until the cause of the disturbance is removed or sufficiently reduced. The implementation of measures appropriate is often necessary.

The reflection of deteriorated areas corresponds to an amalgam view of the impacts caused by soil degradation, plant degradation and also water degradation, because the damage to the environment can be multiple. Resilience is the ability of the system natural to return to its original state after disturbances caused by external forces, such as human actions or natural processes. This term arose in the field of ecology in the early of the 1970 s with analogies to notions such as resistance and elasticity. Resilience was reviewed by Westman (1978, p.705) in several definitions and defined in the concept as "the extent and speed with which an ecosystem recovers its original form and function after a disturbance". In another note on resilience, Holling (1973, p.17) states that it is "the ability of a system to absorb changes […] and continue to exist". According to the author, resilience is not synonymous with stability, but rather with "system capacity". He explains that after a disturbance, a temporary state of imbalance will eventually give way to balance. An environmental destruction occurs when vegetation and animal species decrease; this leads to a negative impact on natural conditions. It can be the result of natural forces that are beyond human control or the actions of human beings. In this regard, there is much debate among international organizations, and most of them see environmental degradation as one of the greatest dangers facing humanity in the era current. Considering that we only have one Earth, with a biodiversity considered without parallel in the universe, the destruction of the environment could be irreparable and would lead, without doubt, to the extinction of man. There is no doubt that the bad influence of people on the environment is significant enough and causes systematic disruptions in natural systems, climate change and resource depletion. These two trends are closely linked; they can be considered problems global that need to be resolved with the help of international collaboration to avoid unfavorable consequences. Among the main disturbances of ecosystems are atmospheric pollution, habitat destruction, soil erosion, desertification, as well as ocean acidification. In addition to these impacts, high growth is expected population triggers increasing pressures on water resources and agricultural land. To find ways to re solve this situation, one solution could be exploration of smart agricultural technologies, but unfortunately, most minerals needed for these technologies are very rare and can only be obtained through sources of clean energy. People's well-being can be considered controlled through mitigation strategies

that involve reducing carbon emissions, and, on the other hand, the adaptation measures, in addition to behavioral changes, are also important. As part of its campaign to control growing desertification in the Northeast, four locations are being identified by the Ministry of Environment, Water and Justice of Amazon. Desertification is a condition characterized by soil degradation caused by drought and other factors, such as global warming and human activities, which prevail in dry or arid regions and in semi-arid zones. This implies negative ecological effects, including, among others, loss of biodiversity, reduced yield and high content of salt, among other results, since salinization associated with erosion causes the loss of fertility, leading to the unproductively of food crops, rural exile, among others. Soil degradation is not an entirely natural process and results mainly of human activities; its origin begins in deforestation, for example, when trees are felled to create space for pastures, plantations or constructions. The rate and level of degradation depends mostly on how the exploitation of soil resources is carried out. Degradation is more evident in poor regions with lower technological levels, which makes desertification play a more important role and have greater implications, especially in case of adverse climatic conditions. The concept of degradation is related to environmental impacts considered harmful, mainly due to human actions. It is rarely used to describe natural changes. The definition varies depending on the activities and fields of investigation in that are detected. As discussed by Holl and Cairns Jr. (1986), biological perspectives of ten address issues related to the development of ecosystems. They highlight the importance of the term destruction or disruption, caused by human actions irreversible. There are three scenarios affected by temporality: sudden interruptions, disturbances overtime and planned interruptions, such as open-air mining. Toy Hadley (1987) address the concept of disturbance or interference, with a spatial focus and associated with geological formations formed in the landscape by human interventions, such as mineral exploration, urban expansion, and agricultural activities. Many of these impacts may be temporary and the original landscape can be restored with proper planning. The studies by Willians, Bugin, and Reis (1990) focused on the mining industry and emphasized the environmental degradation caused by extractive activities, such as the loss of native vegetation, fertile soils, and changes in water quality. They also discussed the relationship between soil degradation

and environmental degradation, emphasizing that the loss of adaptability physical, chemical, and biological of the soil makes socioeconomic development impossible.

Maschioetal (1992) addressed their reversibility of the degradation of ecosystems regional climates, classifying different degrees of degradation, from reversible failure to irreversible destruction of ecosystems. Land degradation occurs when processes environmental factors lead to loss of productivity and deterioration of environmental quality. An example of this is agriculture, which can reduce crop yield sand the aesthetics of the local. In Brazil, soil degradation is identified by technical standard NBR 10.703 as the negative effects of soil properties for different possible uses. This means that the soil is seen as a geographic space, going beyond its material composition. On the other hand, standard NBR 13030, related to mining, defines degraded areas as those with changes caused by mining activity. Brazilian environmental laws often confuse the concepts of pollution, environmental degradation, and environmental impacts. Before the 1980 s, environmental degradation was often referred to as pollution. However, environmental legislation defines pollution as the introduction of substances or energy into the environment that harms living beings. The National Environment Policy Environment describes pollution as the deterioration of environmental quality, which resembles to the definition of environmental impact of the National Environment Council (CONAMA). A more informative and comprehensive legislation defines deterioration of environmental quality as "negative changes in the characteristics of the environment" (article 3, item II of Federal Law no.6.938/81), and in the mining industry deterioration is defined as "process". "That can cause damage to the environment and lead to the loss or destruction of some of its characteristics, such as the quality of environmental resources or their productive capacity" (Federal Decree 97.632/89, which requires the development of a Degraded Areas Recovery Plan (PRAD) in mining activities). These concepts are very similar to the definition of soil degradation in the Brazilian Association of Technical Standards (ABNT,1989). A diverse range of practice scenarios and research in the context of specialized knowledge in urban planning and issues environmental issues related to cities and architecture. With the development of society, taking into account the current situation and forecasts of planning policies, urban decline has been discussed, mainly related with the disappearance of the original uses of urban areas. In short, the

concept of degradation is related to the concept of environmental changes caused by human actions that are considered harmful, even if they are controversial or not controversial. This happens frequently. This situation in urban areas has frequently a negative impact on the actual, planned or potential functionality of the use of soil. Sustainability in the management of ecosystems, as well as the implementation of policies environmental policies to restore ecosystems are crucial factors in improving the quality of life. Environmentally restorative restoration focuses on creating an environment alternative that should promote natural balance and diversity where local communities thrive. However, without human intervention and efforts, it is impossible to regenerate the soil and cultivate new plants in this state of profound degradation. The strategies and measures used in the restoration of degraded lands have been referred as recovery in the strict sense, recovery loosens, rehabilitation and redefinition by Rodrigues and Gandolfi (2001). But if restoration implies attempting to return a damaged ecosystem to its original state, it rarely occurs outside of minimally disturbed environments. From the point of view, “recovery” would be a broader definition that would allow an ecosystem to recover its degraded state, but without having to carry out the complete restoration work. In contrast, reorientation takes the form of converting the deteriorated ecosystem in to a totally different entity, such as a dam or agricultural land. Restoration is a significant part of global river systems, oceans and lakes; in the semi-arid areas of Brazil, a fundamental problem is related to how its natural habitat was destroyed by massive deforestation caused by agricultural deforestation. Generally, when we discuss restoration, it means any activities intended to make a lifeless land flourish with ecosystems.

ENVIRONMENTAL CHANGES AND VULNERABILITIES

The natural history of our planet, Earth, has been represented by eras and epochs. It has more than 3.5 billion years and is constantly evolving, gradually changing its appearance over time. This transformation is visualized in Figure 28, which extends for millions of years representing the continuous spiral of time and spatial dynamics that can be witnessed on the Earth's surface.

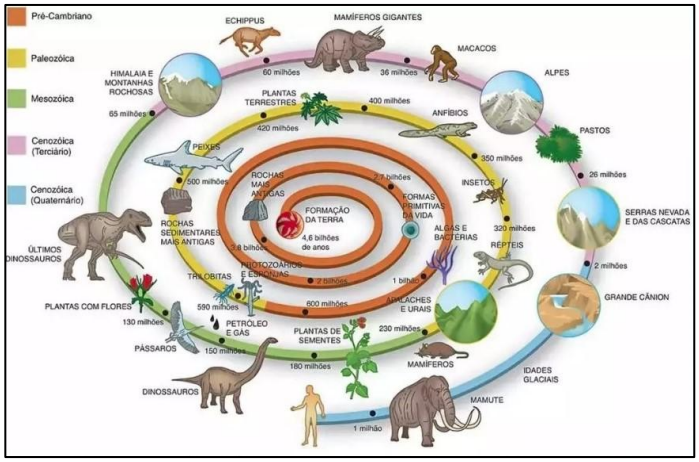

Figure 28 – Time evolution spiral.
Source: PINTEREST (2023).

In our region, the formation of land and soil is strongly influenced by the powerful forces of rain and wind. Such events are indicative of destructive forces that can lead to floods and desertification, which can be accelerated or caused by human activities. Each of these occurrences has a defined process and step, creating an event; although these events occur at different speeds, in one place at a time. The culmination of these phenomena has been witnessed over thousands of years, which still applies to the current landscape of our region.

THE ENVIRONMENTAL QUALITY OF THE LANDSCAPE

Living organisms depend on the environment in which they live and with which they interact; however, however, the environment is largely influenced by the conditions found in a given location. Life support elements, such as air, water and food, are only made available by the environment. We must be held accountable for our environment because it must be of adequate quality to sustain life. Judging environmental quality means making assumptions about its different components (water, air, soil and others) and establishing whether or not they can exist in a particular context of the space-time continuum. It is important to note that quality environmental cannot be seen through narrow lenses. The environment is not simple, but a system composed of several elements, such as soil, water, plants and agricultural land. The interactions of these components give rise to structures space-temporal. Modification of one element can cause effects on the rest of the series. The elements should also be selected in very small

quantities, which can then be combined in abundance. The environmental environment is full of diverse systems composed of lower levels (subsystems) and organized differently, connected through interconnections functional. This context implies the heterogeneity observed in the subsystems, as well as in the their relationships, structure and function. Heterogeneity indicates many elements in a system; for therefore, it may be slight in one region, but may provoke an extensive response when disturbed. This is why complex systems must be differentiated from those behaviorally complex. For those who intend to design a system or an environment, there is at least one set of questions you should ask: where should I intervene in the system? Will there be any impact if I break one of these links? Would you say that this bond is weak or strong? Which are the effects on the external and internal environments of keeping these connections intact in the chain, and also, what about sustainability and resilience in my plan? What kind of disturbance is that? Can you say they are complicated behavioral systems? If a system or subsystem has moved away from its initial stationary state for a long period (say, thousands or millions of years), less predictable and limited any intervention will become. Do not let us fail to recognize that “complex systems” were not created yesterday. The view that should also be discarded is that in which history is divided into many separate eras. It should not be forgotten that the system as it is will change; there is no another way. All systems are “temporarily stable”, but our actions push them towards faster and more powerful state transitions, making them even more unpredictable, erratic and often ending in some kind of disaster. So what can be done? First, we must remember to follow the time and direction of nature. Man's life is an element of the system of nature that he cannot control, but with which he must harmonize. We should not seek to subjugate the history of Nature, but unite with her in a common effort. Nor should it be forgotten that a landscape is a common heritage that needs protection because future life forms will evolve in it who will appreciate its presence and be proud of it as their own achievement. Recognizing the importance of understanding system dynamics is an essential step to ensure ecological connectivity because this knowledge provides the basis for practices of effective management in preserving environmental integrity. Instead of exploring, we should appreciate and explore the richness of the landscape; thus, finding a balance in our

interactions with its characteristics and potentials. Our ability to connect with the Earth is directly related to how closely interconnected we are with the natural systems.

SUSTAINABILITY CHALLENGES

The journey to development in the 21 st century is like an obstacle course dangerous. Many sustainability issues need to be addressed at different levels, from local to global. Although the goal is sustainability, it may seem like a task insurmountable, it implies finding a balance between people's needs, planets and profits people. However, the problem is further aggravated by climate change and increased consumption of energy and resources. These problems related to pollution and major habitat changes have lived by all people around the world and compromise our ability to ensure a biologically healthy environment on Earth. According to the Brundtland Report, a sustainability is defined as the human use of natural resources in favor of society, without threatening the ability of future generations to meet their needs. It covers a biophysical environment, economic, social and institutional aspects.

SUSTAINABILITY

One way to classify sustainability assessment methods is by their scope, such as economic, social, and environmental factors. Weak approaches only look at the economics of sustainability, not taking into account the environmental aspect. Furthermore, the methods of ecological orientation have little consideration for socio-economic relations. Regarding the various indices used to measure sustainability, decision-makers usually prefer those that are more accessible and easier to communicate to people common. However, the creation of composite indicators means the standardization of the indicators, as well as their weighting and the aggregation of information into a number that can sometimes result in errors. In contrast, composite indicators that are easy to understand and communicate for the sake of convenience may not take into account some information very important. The concept of sustainability is much more complex, and trying to describe it in a number can lead people to think that

there are no more details beyond it. It's the inter- relationships between the economy, the social and the environment that create challenges for a future where societies are more sustainable. There is no other major deficiency in the indicators already created because they lack the systemic and holistic nature. It must be understood that, to measure sustainability, we must see it as a complete system with several subsystems that are always in interaction.

UNEQUAL DEVELOPMENT

Research on sustainability seems to be an important topic of a study for human geography and social sciences that focus on spatial inequality and unequal development. There are radical scholars who, consequently, see spatial inequality, but also as an engine of greater sensitivity to the environment. It is said that this happens in different patterns in space, in which post-modern practices are the countries or regions of growing environments of exploitation. They seek economic wealth investing in the internal form; however, importing low-cost products makes the situation only more unfavorable. The types of trade between economies in the emergence of South Asia, China and America Latin are the most exports of environmental vulnerability and unsustainability imposed by laws on neoliberal trade, as well as by the privatized management of the chain of supplies. Underlying causes, mentioned here, the systemic reproduction of the system dominant subordinate, along with low-cost carbon transport and trade of carbon that caused unbalanced unsustainability. One of the factors that aggravate this inequality is a reduction in oil resources and a difficult diffusion of changes in the environment around the world. This can be illustrated in multinational trade agreements, as well as in the global environment, transformed into a combat arena between nations, companies and non-governmental organizations (NG Os) around the world. These asymmetric resource development models also manifest themselves in lower ladders, including suspicious levels between countries, provinces or regions, as well as in cities and districts. The processes and opinions of territorial and marginalized environmental justice are regularly presented in a series of new environmental and planning journals. Similarly, when looking at the consequences of Hurricane Katrina, the clear link between denial or

recognition of climate change, on the one hand, and asymmetry, vulnerability and influence of human poverty, becomes more evident. In an urban environment, wealthy areas also show a dedication to modern green technologies, such as a recycling program in food and organic delivery. In the however, the nearby “food deserts” are vulnerable areas, with a high risk of pollution of the air that cause a decrease in life expectancy. Therefore, the debate about sustainability has returned to life and now discussions about spatial inequality in different levels dominate (cities, regions, national states). At least part of these spatial inequalities also created differences in life patterns and in patterns of the consumer. Sustainable development, in the language of the United Nations, is based on human development that meets its needs without inflicting the application of opportunities for other people to meet their future generations. This means that these needs are not only taken into account by artifacts or physical things, but also ideas and practices, in addition to connections. Freedom of thought and individual decision. In the last 30 years and during four global peaks, from Stockholm and culminating in Nairobi, Riode Janeiro and then Johannesburg, the fact is that sustainable development has became the need of the 21 st century, not the option. Samit Johannesburg focused on the primary importance of nature conservation to maintain a balanced world and sustainable.

The main objective of developing countries is the growth of terms economic, while environmental conservation is an advantage in developed countries. A creation of the United Nations Commission on Environment and Development in 1983, followed by the report of Brundtland of 1987, emphasized the conservation of the environment as an essential element of sustainable development, along with the economy and social justice. Although there were several international agreements and contracts signed between 1972 and 1992 aimed at environmental protection, they were not fully integrated into development policies. In 1992, the government was adopted at the federal summit to adopt the 21 st century agenda, which was in development and environment, while global forums called NG Os to the discussion\about the sustainable development strategy. This means a change extraordinary in the participation of civil society in the national development table and international sustainable. The non-translation of Agenda 21 into effective measures for sustainable development prepared the country for the World Summit in Johannesburg. The city promoted about five hundred sustainable development

partnerships between the public and private sectors, although few did. With Johannesburg disgruntled in September 2000, global leaders announced their final strategies to achieve the development goals of Millennium 2015 (MDG), placing poverty, hunger and education in the spotlight. These problems are interconnected and therefore must be addressed globally. Unfortunately, the report on 2007 indicates that most of these MD Gs may not be achieved by 2015. Even the countries that participated in the summit on Earth did not put in risk the resources to implement Agenda 21 and Samit Johannesburg did not satisfy the expectations in that regard. The focus of the summit was considered insufficient because it did not give priority to critical areas such as education and human capital. It is important to note that the scientific and technological skills are essential components of development and efforts to improve should guide educational and research institutes. An example of an institutionalized learning system for life for social innovation is education. The United Nations Decade of Education for Sustainable Development, in 2005, was fundamental in changing and engaging education at all levels, basic, secondary and universities, as a means of promoting sustainable development. In the field of geography, it contributed to research on issues such as urbanization problems in Great Britain, as well as climate change in some parts of rural Africa. The geographical debate on sustainability is considered a core because it provides a link between environmental sciences and economic, political and cultural changes. In that point, sustainable development is one of the most important political objectives that always are considered, regardless of the level or type of existence. The term “Sustainable Development” is listed in the report of the Commission Brundtland of 1987 as a term to be described; “Development that meets the needs of the present without compromising the ability of future generations to meet their needs”. The idea at the base is that it is not reasonable to interrupt all future development. It can be said that the main international organizations, i. e. the United Nations and the World Bank, already have a consensus on sustainable development as a vital political goal. The search for innovative approaches to remove poverty is considered an important mechanism. It is with this context that this article attempts to examine the evolution of this consent and the resulting policy, particularly in terms of local environmental problems and global. In this chapter, we will consider how human geography helps to explain the challenges political for sustainable

development, in particular those related to violence and conflict, which has long fascinated geographers. The United Nations Conference on Sustainable Development for 2012 was the place where world nations discussed and established a series of objectives that should be achieved. These objectives extend the progress achieved by the MDG, which contributed significantly to reducing global poverty, but also admits that it is still much work needed. Complete poverty and hunger, to provide quality education and medical care to all, to achieve gender equality and promote growth economic, preserve the natural resources of our planet and respect for the rights of nature is fundamental among these sustainable development goals (SD Gs). For sustainable development, it is essential to involve economic progress and social, with a particular emphasis on reducing the level of poverty, as well as improving the ways of life of future generations. In this context, resources must be observed by a global perspective, through which appropriate management strategies can produce positive results in terms of short-term socioeconomic gains and benefits long-term environmental. Sustainable development implies a balance between economic progress, environmental protection and social justice; these three dimensions are substantially called human, planet and prosperity. It is important to note that sustainability approaches must be holistic adopted in all sectors, from megacity, agriculture, infrastructure development, energy sector, through renewable sources, such as solar energy or wind turbines, the method of water conservation, rainwater collection systems. Figure 29, below, occurs to interweave the pillars of sustainable development so called.

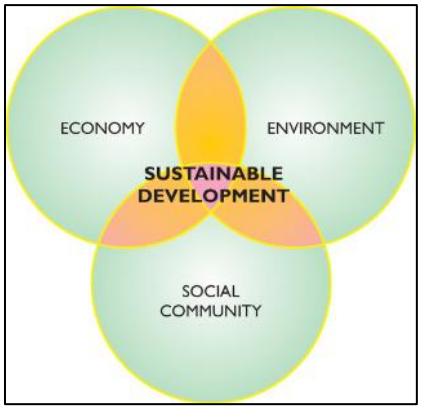

Figure 29–Pillars of Sustainable Development.

Source: Muralikrishna (2017)

Different goals may seem contradictory during a certain period, such as business development, which is not in line with the protection of natural resources; however, in the long term, the sustainable use of natural resources can allow for the sustainability of industrial growth in the future. In addition, businesses and companies that promote sustainable policies as part of their corporate citizenship obligations contribute positively to national economic development. This is necessary because in consumption-based market systems, people live with lifestyles modern people who use resources with very little control and little attention to their needs; however, a delicate balance must be achieved between satisfaction without reducing the quality of life. When it comes to promoting social development, this can be achieved by through multiple means, such as an acting laws designed to ensure that people are protected from pollution and any dangerous factors that may pose risks to their health. On a similar note are efforts to instill a sense of responsibility in environmental conservation, where people need to understand the effects of deforestation and advocate for compliance with goals that can help limit climate change. Environmental preservation is fundamental regardless of the 4 Rphilosophy (Reduce, Reuse, Recycle); helps save the environment. Regarding sustainability, the green companies are more inclined towards an environmentally friendly approach, while companies that do not apply measures tend to worry less about carbon emissions. At the same time, many people are convinced that the conservation of natural resources is not only a pressing issue, but also a major concern for the future of humanity. Green policies and practices essentially involve pollution control, ecosystem preservation, air resource conservation and sustainable use. A the use of technology plays a vital role in promoting the development of a greener future and, at the same time, achieving sustainable growth without causing damage to our environment. To overcome this gap, it is possible to use indicators because the joint training process helps representatives from different communities to understand what sustainability means. Indicators make it possible to incorporate sustainability into a broader set of context-based concerns and offer new measures by which progress can be measured. Although some of these notions may seem quite far-fetched and impractical, something as simple as the human ecological footprint could actually link all these actions to crucial issues related to sustainability. The definition of sustainability has undergone changes over

time. The Brundtland report on sustainable development goals is quite relegating this regard. Sustainability is an over arching concept and, as such, can be addressed by a number of paths, with social sustainability considered a route less safe or mysterious to the others. Its relative invisibility contrasts significantly with readily available economic and environmental indicators. Of the sustainable development models, three models are generally seen: environmental, economic and social. Among these components of social sustainability, we can find justice in society, living standards, equality in access to health care, local development, a sense of common values among neighbors and communities, stability and integration of people into society, protection of workers against exploitation and violence as part of labor rights; the duty of companies to ensure that all its activities correspond to high moral standards while working with other organizations, including the government itself, is a characteristic of responsibility Social; the willingness to accept human diversity, both on the part of an individual and of a community, is defined as cultural competence; the strength and durability of a community facing crises such as natural disasters or economic recessions is what means community resilience; finally, the success of people in dealing with new situations, such as technological innovations or changes in political systems, can be captured in human adaptability. Social sustainability is another innovative strategy, which requires all sectors that build sustainable development to be socially applicable. It includes in its mandate all human acts and the relationship between society and nature; in other words, it transcends only economics, ecology and social concerns. To contribute to sustainable ports that also address social, economic and environmental aspects, can be used service level agreements. Sustainable operations in the port and its hinterland are among the main issues investigated by several international projects. The Port of Amsterdam is a model example, which identified five areas where sustainability measures are practiced. These areas include energy transition, circular economy, environment, maritime transport clean and safe, work and knowledge, and responsible trade chains. Emphasizes also that partner ports must also implement sustainable measures to promote environmental, economic and social sustainability. A common way to understand sustainability is in terms of three aspects: environmental, economic and social. Given the close interrelationships between these goals, it is crucial to be addressed together in their entirety to effectively promote development sustainable.

An example could be the fact that ports adopt approaches of environmental sustainability without considering the social aspect. The issue of sustainability economic emanates from the incorporation of appropriate environmental and social practices. A study revealed that the morale of port workers is a critical determinant of port sustainability. To identify all the measures that contribute to the development of sustainability in the port and consider the interests of the various industry stake holders, the scope of the investigation was expanded. The following chapter addresses then how working conditions impact the well-being of workers and, therefore, on environmental, social and economic sustainability. The loss of scenic beauty, such as the degradation of natural, urban or cultural, can create significant socioeconomic influences, influencing communities, local economies and even collective identities. The direct impacts concern: landscapes disfigured or polluted reduce the tourist appeal, harming regions dependent on tourism (e. g. polluted coastlines, deforested forests); the loss and devaluation of areas, consequences of the loss of views or visual pollution; mental health and social well-being; relationship with cultural identity and social cohesion, a consequence of uprooting symbolic, as part of the collective memory and finally, the environmental inequality that says respect to the poorest communities that are affected by the loss of scenic beauty, because they have less access to preserved areas and suffer the consequences of this loss grand to their natural coexistence.

CHAPTER XII

BRIEF HISTORIOGRAPHY OF THE MINERAL SECTOR OF THE BRAZILIAN SPACE

The detection of gold in Brazil was considered are life from the economic difficulties in Portugal for the low performance of sugar. Gold became an external Brazilian during a mineral survey of the Portuguese colony and made it one of the largest gold producers of the time. However, all this gold was sent to England by Portugal. The mining sector was rigidly controlled by the Portuguese authorities, depending on the military strength of Great Britain. Minas had powers for an overview of the mining operations and the

collection of taxes on mineral extraction, as well as respect for safety measures. To remove unauthorized trade, several castes were established to convert the gold pepper into the bar. The Brazilian gold mines are located near Rios, which facilitated the mining of the mining process, but also caused the exhaustion of the mines. Later, the gold rush began in the 80 s with the appearance of Serre Pelada, one of the largest open-air mines in the world. Although the mineral industry has its negative effects on society and nature, it is also one of the main employers and sources of income for many Brazilians. The first research carried out was in the state of Amapá by Creoles and the French who passed through the place and the Casipol Riverin the Salamanangón mine. Clotilde Salamanangón was a representative of the French interests that participated in the search for gold in the Brazilian countries. Initially, mining was practiced as an individual enterprise, in which the miners followed rivers and waterways in the hope of finding precious stones. Subsequently, these activities were institutionalized in cooperatives and companies, providing employment to a considerable number of workers. During the twentieth century, the Brazilian mineral industry contributed significantly to the terrestrial economy, especially in the Amazon. Minerals, including gold, diamonds and other stones, were enriched by people, but also caused negative environmental impacts, as well as people, such as destroying forests and exploiting poor workers. Although mining is practiced with environmental limits, it is still an important economic activity in some of the regions of Brazil. In fact, the state of Minas Gera is contributes to a large percentage of growth national and international economic, allowing other areas, such as development of infrastructure, technology and professional training. The country is so varied in topography and geology that Brazil can be considered one of the richest nations that produce roughs in the world. Brazil has a high potential in mining due to the high diversity of land and geological formations in its extension, which gives it a high diversity of minerals. [...] both in reserves and in mineral production, reached the value of US$ 40 billion, which represented about 5% of the country's Industrial GDP. In Foreign Trade, the mineral extractive industry contributed with more than US$ 34 billion in exports of ores [...]. Significant investments preceded such production of mineral goods, which, to give continuity to the exploration and exploitation of new mineral deposits, are estimated at US$ 53.6 billion in the period 2014/2018 (IBRAM, 2015). Figure 30 shows

the influence of mineral goods activities on the national economy verified in 2014, according to DNPM 2015.

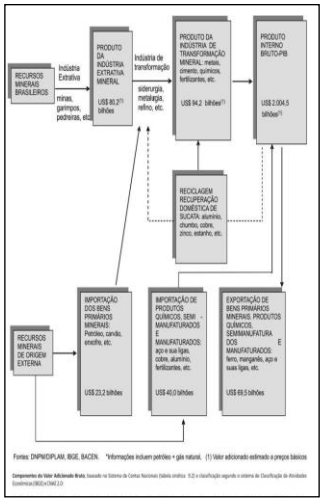

Figure 30 – Influence of mineral goods on the national economy in 2014.
Source: DNPM (2015).

The summary of minerals for 2015, prepared by the DNPM, base year 2014, presented a flow diagram that showed the influence of mineral goods on the national economy (Figure 30). The mining sector encompasses a wide selection of activities, including the extraction and processing of oil and gas, as well as the research and exploration of coal and non-metal minerals. This area includes the removal of iron mineral from the soil, for the benefit of processes more complex, such as agglomeration. In addition, the extraction of a mineral or also is part of this sector, including the processing phases of these materials. With regard to the mineral processing industry, it is not limited to the action and treatment of minerals, but also extends to different production sectors. For example, there is the production of beer and the refining of petroleum products in refineries, as well as the production of BUN and various chemicals, organic and inorganic. This sector also includes the production of resin, elastomeric, parasites control products such as insecticide sand repellent, in addition to colors and light. In addition, the production of rubber objects, which include products such as tire sand tires, as well as plastic objects, except for tubes and laminates, is a significant part of this industrial branch. Other relevant activities include the production of non-mineral products metallic, iron and

surgery in steel producers who perform hot lamb strips or lining in addition to these, there is the production of seamless steel pipes and other iron foundries, as well as the metallurgy of non-ferrous metals, among other operations.

CHAPTER XIII

OVERVIEW OF RECOVERY OF AREAS DEGRADED BY MINING-RATION/GENERAL CHARACTERISTICS OF MINING IN BRAZIL AND THE ENVIRONMENT CONCEPT OF DEGRADATION

The manipulation of the area is described when it is subjected to removal or destruction of vegetation and fauna: when the terrestrial layer is removed or buried; when the quality and speed of the water system are subjected to changes; and when there is a loss of adaptation to the physical, chemical and biological characteristics in the environment and, consequently, in the announced socioeconomic development (ÂNGELO, 1999) is not observed. Degraded soils are characterized by the presentation, in comparison with the natural conditions, low levels and organic or nutritive nutrients, in particular carbon, nitrogen, phosphorus and sulfur, low water infiltration and high compaction, resulting in a low biological activity of the meso and micro fauna, which makes them in appropriate for a good development of vegetation cover (RUIVO, 1998). According to Federal Law No.6.938/81, known as the national environmental policy, believes that the environment is composed of physical, chemical and biological conditions that allow the existence of any type of life. Environmental quality management is a reduction or loss of property compared to its indicators. The manipulation of soil organization for nutrition and agriculture (FAO) describes as a loss of the capacity of ecosystems to provide goods and consist of services due to changes in soil quality. Although many causes lead to environmental manipulation, one should not forget that people are its main contributors. They cause the destruction of habitat, create long-term environmental changes and reduce the amount of space for wild animals. In addition, natural changes have also influenced the environment, such as land penetration, earthquake, tsunamis, hurricanes and forest fires, which can gradually weaken the life of herbs and animal species.

DEGRADATION AND MINING

In Brazil, the main environmental problems are related to mining and they correspond to water, air and soil pollution, with coal fires, radioactive funds unnecessary and underground degradation (MARTIM; SANTOS, 2013). In addition, it must be borne in mind that, in the process of mining and processing minerals, there are actions that can negatively affect the environment, such as the construction of dam, river diversions, natural disasters, unstressed methods of waste, disposal, derived forests, misbehavior and introduction of species exotic species that negatively affect indigenous plants. According to Callisto, Gonçalves Jr. and Moreno (2005), activities can be considered causing negative environmental impacts because they influence the sharp decline in biodiversity of water and have a major impact on vegetation and microorganisms. Environmental effects are generally associated with various phases of research on goods minerals, such as the opening of coffee (removal of vegetation, excavation, soil movement and modification of local landscapes), the use of explosives in rock dismantling through atmospheric pressure, soil vibration, fragments, smoke, gas, dust, noise in powder, for the transfer and benefit of the mineral (creation of dust and noise), which affects the means such as water, soil and air, as well as local inhabitants (PATRICIO; SILVA; RIBEIRO, 2013). Observing the environmental impact on a particular company is the first step to propose reduction in theme assures and, in the case of mining extraction, and the study of environmental impact caused by mining activities or any other industrial activity is of fundamental importance. As these environmental problems have become a concern growing to reduce the quality of life and the risk offered to human health (QUADROS, 2009). Several studies have underlined that the task of environmental protection is not limited to the environment of the Department of Environmental Protection, but the company is divided, in general. As indicated in article 225. Preserve nature for a good of spring; however, it is essential to remember that the removal of non-reference from resources should always be done understanding the time necessary until their substitutes, so that they do not interfere with the natural balance, promoting thus the practice of sustainable development. The most characteristic influences on the environment of mining activities are the related: visual degradation of landscapes, dismantling of

consolidated materials (rocky and very compact masses), which are sometimes carried out by means of explosives, also noise; and a demonstration of solid waste, usually in the form of dust (SILVA et al. , 2007). According to NBR 10.004, by ABNT(2004 a), solid waste is considered a waste in solid and semi-solid countries, due to the activity of the community of origin: industrial, domestic, hospital, commercial, agricultural, services and cleaning. This definition includes a sludge from the water purification system, those generated in the equipment and structures of contamination, as well as some fluids whose special characteristics are guided in sewers public or bodies of water, or require technically and economically unsustainable solutions are in the face of a better technology available. Also according to NBR 10.004, from ABNT (2004 a), solid waste is classified, by its hazardousness, in: Class I (hazardous): are those that present hazardousness, depending on their physical, chemical or infectious properties, or one of the following characteristics: flammability, corrosivity, reactivity, toxicity or pathogenicity; Class II-A(non-inert): are those that do not fall into the classifications of waste class I or class II-B waste. Class II-A waste may have properties such as: combustibility, biodegradability or solubility in water; Class II-B(inert): any waste that, when sampled representatively, according to Standard NBR 10.007(ABNT,2004 c), and subjected to a solubilization test, according to Standard NBR 10.006 (ABNT, 2004 b), do not have any of its constituents solubilized at concentrations higher than the water potability standards, except. In the field of mineral research, the removal and transport of enormous amounts of materials is practiced. The amount of waste generated depends on the way in which the minerals extracted the richness of the mineral content of the rock and the depth of the bearing. In mining extraction, waste can be classified into two types: waste, excavated during mining, but do not have a market value and random waste, which are mineral materials due to the mining procedure. In addition, there are other wastes, which consist of a very diverse series of materials, such as the processing of wastewater created in mining systems, batteries and carcasses of tires used by the vehicle fleet, the operation of extraction and mineral processing (SILVA, 2001). The mining activity abundantly creates amounts of unnecessary tailings for the industry, which are usually stored on benches in the large area of mining leases or public lands. Mining activities are detrimental to the environment environment and there foregoes challenge to

sustainable development in many parts of the world. Some of these influences include the exhaustion of green surfaces, soil pollution, loss of plant and animal species, a reduced quality of supply and water, air pollution and, finally, the negative effects on human health and habitat health. In this sense, the vegetation cover is necessary to all eviate these damages and is a key factor that determines the environment. Figure 31 shows us the recurring impacts of mining.

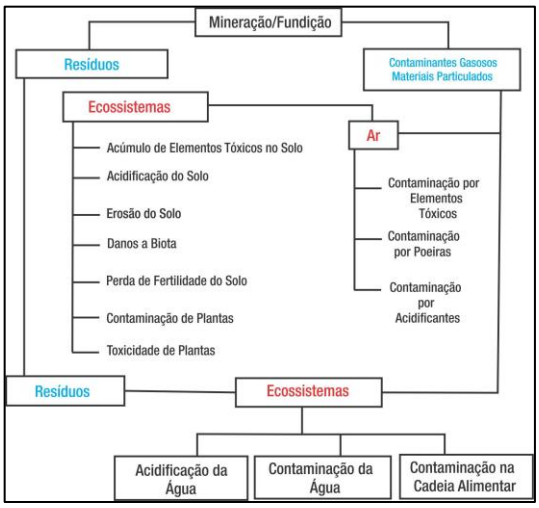

Figure 31–Environmental impacts of mining
Source: Dudka and Adriano(1997).

Reduced vegetation can causes oil erosion which leads to movement and migration of smaller and lighter particles, such as humus and clay. These particles are fundamental to maintaining oil fertility. Erosion transports sediment to bodies of water, weakening its quality. In addition, the absence of vegetation negatively affects the air pollution through soil pollution and also causes loss of fauna and flora. Therefore, vegetation cover is an important factor in determining the quality environmental. Based on the type of mineral and its absorption capacity, the effects of minerality on the environment are different. In this context, mining activities can have long-term consequences for the surrounding landscapes, ecosystems and communities.

CAUSES OF DEGRADATION DUE TO MINING

Among the factors responsible for pollution through mining are the following: Soil disturbance will be continuous, which will causes oil damage and silting of bodies water, resulting in degradation. Land use planning is an important factor in determining the preservation of natural resources; Air, water, soil and noise pollution is harmful to the environment and human health. This is because sustained exposure to high noise levels can have permanent effects, while water or soil contamination can also contribute to such effects. One of the issues that currently directly affects the environment is over population, due to the fact that a high rate of population increase puts pressure on resources natural resources, the agricultural sector, the demand for housing and waste management, which in turn contribute to environmental pollution. Waste in landfills can be a major threat to the environment and also to the people who reside in the surroundings. In addition, waste incineration contributes to environmental pollution. According to the fifth assessment report of the Intergovernmental Panel on Climate Change, deforestation is mainly the result of population growth and urbanization; however, it also results in the release of carbon into the atmosphere, contributing thus to global warming.

LEVELS OF DEGRADATION BY MINING ACTIVITIES

The levels of degradation are subject to some assessments, namely: Soil assessment based on the distribution of metals on the surface and subsurface– A set of negative environmental impacts of mining includes director influence indirect about plants, soils, sediments and water. The estimation of these consequences with the help of environmental geochemistry is known. Geochemistry focuses on the study of the chemical properties of the Earth and celestial bodies, such as rocks, mineral sand water. A soil pollution from mining activities can be determined through the distribution of metals in the soil. Soil samples were collected at different depths to measure the levels of contamination. Based on the concentrations of the metals detected, are calculated industrial pollution indicators; Sediment sample assessment to obtain composite sediment

samples, subsamples were collected from five different locations in the section varying between 250 and 500 meters in length, at depths ranging from 0 to 25 cm. As soon as the collection is completed, you will need to perform the following actions: to prepare a composite sample, mix small samples and discard 1 kg of material. A sieving procedure wet is applied when dealing with complex samples that can be carried out on site, or a dry sieving method would be required to analyze the menthe laboratory. The inclusion of nylon fabric filter (0.15 mm) is an essential measure to avoid contamination. Soil with a particle size of 50 to 100 grams and 0.15 mm is frequently used. To achieve analytical fineness, sample homogenization can be performed using a gate ball mill; Stream water assessment – River water sampling must follow the following procedures:

1) for each location, two water subsamples must be collected; 2) use trace element-free polyethylene bottles to store the collected water; 3) a control sample, collected every 20 a sample, must be filtered and preserved in the same way as the real samples; 4) the bottles have to be filled with distilled water and acidified with 1.0 ml of super pure concentrated HNO 3 using a drop per bottle. Acidification allows the material to be evaluated up to a week after the campaign sampling; 5) for an ionanalysis, unfiltered water should be used while formation analysis, the water sample must be filtered, using 0.45 disposable filters mm coupled in syringes; 6) for mercury (Hg) analysis, the subsamples can be completed with unfiltered water, while for Organic Carbon analysis Dissolved (DOC) filtered water samples can be used; 7) water samples must be analyzed for temperature, Electrical Conductivity (EC) and pH in the field, while alkalinity must be determined by titration in the laboratory; Ground water assessment–Before sampling ground water, it is important to remove stagnant water from the well, following the procedures:1) sampling should occur after EC stabilization of ground water; 2) the use is recommended of portable samplers. These are simple to use and relatively easy to clean; 3) it is recommended to rinse the collection containers ever all times before collecting the sample; Plant assessment–The content of chemical elements in plants was determined from samples of plants taken from lettuce, giant kale, cassava, potato leaves sweet, corn, rice and grass. Sample collection should include several plants of the same species from the same location. The plant material to be sampled differs in chemical analysis for different samples, but is generally based on how much will be suitable for analysis. For wet

digestion, 1-5 g of dry sample would be sufficient, while for analysis of plant ash, 15-30 g of dry tissue would be sufficient. Sample processing of plant tissues to be sent for laboratory testing involves washing the field samples collected with running water and oven drying at a certain temperature. The material must then be pulverized in a milland then sent to the laboratory for further analysis.

ENVIRONMENTAL IMPACT ASSESSMENT

The concept of "Environmental Impact Assessment" (EIA) originated in the field environmental through the National Environmental Policy Act (NEPA) of the United States of America or the National Environmental Policy Act, which created this planning tool environmental. NEP was passed by Congress and came into effect on January 1, 1970, also serving as a model for similar legislation in other countries. NEPA also requires exhaustive studies on the environmental effects that occur as a result of federal projects. The 92 nd United Nations Conference on Environment and Development, held in Rio, contributed to the global dissemination of EIA. Among others, there was the Declaration of Rio as one of its highlights, in which Principle 17 underlined the centrality of EIA: Environmental impact assessment, as a national instrument, shall be under taken for proposed activities that are likely to cause a significant adverse impact on the environment and subject to a decision by the competent national authority. In another document resulting from the United Nations Conference on Environment Environment and Development (UNCED), Agenda 21, the signatory States recognize the EIA as an instrument that should be strengthened to stimulate sustainable development. Several times Agenda 21 mentions the need to assess the impacts of new projects of development. Mentions of the role of the EIA appear, among others, in the following items of the Agenda 21: Ensure that relevant decisions are preceded by environmental impact assessments and that, in addition, they take into account the costs of possible ecological consequences; (in Chapter 7–Promoting sustainable development of human settlements [7.41 (b)]). Promote the development, at the national level, of methodologies appropriate for the adoption of integrated energy, environmental and economic policy decisions with a view to sustainable development, interlaid, through environmental

impact assessments; (in Chapter 9–Protection of the atmosphere [9.12(b)]). Develop, improve and apply environmental impact assessment methods with the aim of promoting sustainable industrial development"; (in Chapter 9 – Protection of the atmosphere [9.18 (d)]). Carry out investment analyses and feasibility studies that include an assessment of the environmental impact, for the creation of forest processing companies; (in Chapter 11–Combating deforestation [11.23(b)]). The first environmental studies carried out in Brazil in the 70 s for several plants hydroelectric plants were generally due to the influence of foreign needs, such as happened in other countries. During the 70 s, significant economic development was achieved significant and the limits were opened. It is significant that the enormous extensions of Cerradas and Amazon gradually became part of a market economy. In this expansion, the primary source is based on government investments in projects of infrastructure, including the construction of the Trans-Amazonian highway and the ITIP Factory. The assessment of the environmental impact is a critical relationship used to determine the effects of the project on the environment. In addition to indicating recommended strategies to mitigate or compensate for these influences, the measures also determine the paths of reduction. The document is then used as a tool during the EI trial, in the witch project promoters, governments and involved parties negotiate publicly. According to the Federal Constitution of 1988, the analysis of environmental impact is considered one of the main tools in the protection of natural resources. In the feasibility study phase, the public bodies may require an environmental impact assessment for projects that may cause major environmental damage. As Milaré (2021) observes, the assessment of environmental impact in Brazil is a means significant of organizing and managing environmental licenses from decisions in terms of aspects such as the environmental quality of the project, program or initiative. Environmental permission could only be approved if the path and Rome was made based on CONAM resolution 001 of 1986. The RIM must be open to public advice with the opportunity to maintain the public hearing on the matter. The definition of environmental impact is characterized as changes in the characteristics of the environment, which are the result of human activities that influence health and the quality of natural resources. Public hearing Adjust Resolution No. 9, since 1987, published in 1990. The World Summit on Sustainable Development, held in August and September 2002, showed great interest in

Brazil for environmental issues and also demonstrated the importance of these problems for Brazilian society. Environmental issues have increased in complexity over time and are now frequently defined as the main problems in the world. Those that initially were technical and scientific discussions have now expanded through political, economic and social domains. This was obtained from discussions and actions at multilateral conferences, such as Stockholm, Rio de Janeiro and Johannesburg. In 1972, leaders from several countries met in Sweden during a conference in Stockholm to discuss global environmental issues and their possible solutions. The main objective was to raise awareness of the importance of environmental protection and find away to promote sustainable development. This event is a turning point in the history of sustainable development that has influenced several laws and the protective environment around the world. The Stockholm Conference occurred when the world realized the conservation of nature as a growing international concern and faced growing criticism from all spheres of life in terms of damage to environmental pollution to the benefits of people. Consequently, the scientific community and non-governmental organizations in the countries developed, in which public opinion and political pressure received significant support. The Rio de Janeiro Conference (1992) presented the idea of development sustainable as a way to deal with environmental issues. The basis of sustainability is the balance between economic, social and environmental factors. This meeting also underlined the role that developed countries played pollution and invited them to assist poor countries to achieve environmental development through financial and technical support. In short, changing attitudes based on issues environmental issues are innovative. An example of how global challenges, such as trade, financial and environmental protection, was interconnected by Johannesburg. After the Doha Conference and Monterrey, the welcoming summit reiterated this point of view having been seen as a point of important turning point to strengthen mutual cooperation between nations. Active in the United Nations and playing a significant role in environmental discourse, Brazil is often involved in international jobs with a loud voice. Interest in the topic of the environment has spread to Brazil and the world, especially in developed countries. Although the situation differs in environmental conferences, it is still seen as one of the main leaders in this sector, although not without contradictions. Not only do the economy

and the environment in Brazil determine its relationship with issues environmental; this attitude may be the result of internal struggles between different interests contrasting that are directly or indirectly influenced by environmental problems international. In addition, Brazilian territorial expansion and its natural resources, together with regional inequality and social inequality, played a significant role in the formation of this attitude. NAFTA, natural gas and various minerals are the main resources of Brazil, making it significant in the world economy. Its strategic position, along with a vast coastline, simplifies international trade and economic cooperation with other countries. Pressure from the international community has increased, which has led to the introduction of measures more serious environmental issues; in addition, the need to find a balance between economic development and environmental conservation is increasing. Furthermore, in the recent years, the rescue of the Amazon has become a priority because they saw the appearance of large fires in the 80 s. Although Brazil develops on different fronts, such as industry, agriculture, science and technology, they have not yet faced the internal differences that must be done. It is necessary to establish a production and consumption model that meets the basic economic and social needs of all human beings, a component of sustainable development. Brazil is not on the fringes of the Environmental Conference because it includes its importance for national progress. Environmental negotiations are becoming more important in commercial and financial discussions, in particular when referring to countries in developing countries such as Brazil, China and India. However, in the search for technology financing and in the transmission of sustainable development, it is inevitable to appear a conflict of interest between developed countries and these developing countries. The fear is that, with regard to environmental issues, it could create new barriers commercial. For this reason, it is important to study Brazil's participation in three conferences of the United Nations dedicated to environmental issues, taking into account the evolution of these issues, as well as the political and economic changes that have occurred in Brazil, since Stockholm to Johannesburg. I tam array’s negotiations on Brazil's positions were reflected in a series of statements and speeches representing Brazil a policy. The future environmental assessment is the way through which the assessment of potential influences aims to predict changes in the environment that will be derived from the plan currently proposed in the discussion. For

the International Association for Impact Assessment (IAIA, 2015) “The assessment of the effect, simply defined, is a procedure to identify thefuture consequences of current or proposed action” (ALMEIDA; GARRIDO; ALMEIDA, 2017, p. 1). Therefore, the EIA is a planning tool and aims to avoid significant growth in the involvement of government, academic communities, non-governmental organizations and all sectors of society in dialogue on sustainable development is relatively new and obviously in recent years. For this reason, it is important to study the relatively new and obviously in recent years. For this reason, it is important to study the formal participation of Brazil in three United Nations conferences dedicated to issues environmental, considering the evolution of these problems, as well as the political and economic changes that have occurred in Brazil, from Stockholm to Johannesburg. The Italian negotiations on Brazil's positions were reflected in a series of statements and speeches that represent Brazilian policy. Thus, the EIA is a tool of planning and aims to avoid or minimize the problems arising from anthropic activities (SÁ, 2004). Consequently, it is useful to preserve natural resources, protect biodiversity and maintain the quality of life of the Brazilian population.

DEGRADED AREAS RECOVERY PLAN

The initial assessment phase of the area in question is the creation of the exacerbation activity and its environmental consequences. In this sense, adverse effects in different sectors, such as agriculture and industry, should be considered to decide the type of action needed. These measures may include, depending on the extent of degradation and consequences, measures for emergencies such as the creation of limited areas, the evacuation of communities on display and even the installation of alarm systems. ABNT Standard–NBR 13030–determines the principles that mining companies involved in the renovation projects of these areas will follow aiming at its technical authorization, to guarantee the conservation or improvement of the environment, regardless of where this project may be implemented. When project store structure degraded mineral activity areas develop, it is important to consider some elements provided for regulation. The information should be included in the following elements: topographic conformation and landscape; stability, erosion control and drainage; landscape suitability; Reversal;

Supervision; Physical Program and Financial Program. The objective of these plans is to reverse the damage caused by human activity, promote good health in society and allow the future use of these areas. The PRAD is prepared as a necessary decree step. The project must be presented in rhyme and reason, according to Law No. 97,632, of April 10, 1989. When mining occurs, recovery is an important part of the process that ensures that affected areas are returned to the previous state that resources become us a bleand productive again. While this may include renewing conditions before management, it is not necessary. Rehabilitation should continue in all phases of mining, including periods before and surgery of mining. Efforts in reconstruction should be carried out through a well-defined plan, conducted simultaneously with the extraction process, but in different stages: 1) assessment quantitative or qualitative of the degree of degradation; 2) assessment of the expansion of the area in which the change occurs; 3) the environmental significance of degradation; 4) technical and economic efforts necessary for recovery; 5) risk analysis for the health and safety of communities affected; and 6) the use of the surrounding land.

The main activities that combine a plan for the rehabilitation or recovery of the degraded area are summarized in Figure 32, below.

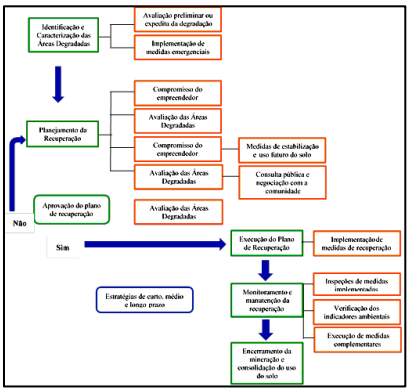

Figure 32–Activities for the PRAD.

Source: Santos (2017).

IDENTIFICATION AND CHARACTERIZATION OF THE DEGRADATION AREA

An estimate of the regions influenced by mining and a description of these areas makes it necessary to consider and evaluate many aspects: Mapping–The use of technologies such as maps, satellite images and aerial photographs can be applied to determine areas that have suffered environmental damage, among others; Geological and geotechnical investigations – To effectively restore fragile environments of the which recovery depends on, it is essential that studies are carried out in both natural and laboratory environments. For example, assessments of soil quality or persistence of accumulated waste should be carried out before any corrective actions are taken; Meteorological and climatological investigation – For example, temperature, precipitation, humidity and wind direction are some of the variables that can be considered in measuring environmental and human health damage resulting from pollution of air or water; Hydrological conditions–The assessment of water resources in any location takes into account factors such as quantity, quality and dynamics of groundwater and surface. Hydrological processes depend on climate, geology, topography, types of soil and vegetation cover of a given area. Although climate plays a role fundamental in determining the path that water will follow to enter water bodies, other factors also shape how water moves across the Earth's surface; Topographic conditions –When we talk about topography, we mean a state in which the surface of a given territory is considered rugged, rough, undulating or smooth. Restoration strategies and techniques can also be influenced by the topography of the area around the site. This is because it is essential that there stored area is well integrated with its natural environment, so that materials and energy can easily pass through this surface; Soil conditions–The amount of water retained by the soil is determined by several elements such as texture, cohesion, density and soil depth. These factors influence plant vitality, nutrient leaching, as well as the replenishment of groundwater; Vegetation condition–The diversity, quantity and quality of plants in a location show how well an ecosystem is functioning and the impact humans have had on it. The plants in the region can be native or exotic, fragile or resistant, common or threatened with extinction.

RECOVERY PLANNING

However, this planning process begins with defining objectives for redevelopment planning, identifying future uses of the area and preparing a revitalization plan for this purpose. Restoration objectives can be studied with based on various theoretical and practical methods. In summary, restoration strategies aim to establish a balance of conditions ecological under which the affected areas can be integrated back into the biomes worldwide. These would incorporate landscape remediation efforts, carrying out the designs and landscape preparations of the project, soil replacement operations, planting vegetation in place of sustainable cover in the affected areas, as well as monitoring and supervision continuous of the area to prevent recontamination. This planning, therefore, would follow the following progress:

Topographic reconstruction: to begin, rehabilitation planning establishes the objectives, identifies future uses of the area, and then develops a plan for revitalization. Different theoretical and practical analyses can be done for the purpose of restoration. In short, restorative strategies aim to establish ecological conditions stable through which affected regions can be reintegrated into global systems. These measures involve landscape regeneration, ensuring readiness for the landscape development, soil replacement, the introduction of plant species and the constant supervision of the area;

Topographic design: it is crucial to consider the characteristics of the post-restoration soil in opposition to pre-deterioration characteristics. Where topsoil is temporarily displaced, measures should be implemented to prevent erosion and run off. Also it is necessary to apply flood and sand control measures to prevent destruction. A landscape restoration plays an essential role, as the strata will help to shape future restoration techniques and land uses; Top soil replacement and soil reconstruction: to place plants on site restored, a substrate suitable for the plants must be used. Although materials geological are frequently employed, it is worth looking for solutions that meet well to the requirements of the species. The top soil layer is loaded with seeds, nutrients and organic matter for vegetation regeneration in the efforts of reforestation. One way to recover these lost soils is to store them and use them again in the reconstruction of eroded parts. Water stress is a possible effect if plants do not have a cover of vegetation and, if these areas are

renovated, materials that do not retain water may be present, causing the evaporation of substances to higher temperatures and loses another. When soil is used, it is worth practicing good soil management techniques that can guarantee its reuse. One of these methods involves the first step in removing the surface layer of the soil before digging and immediately replacing or accumulating it at an appropriate point. Another way to prevent erosion of this layer is through proper dispersion along the riverbank. In addition, the stabilization of grass and shrubs in the top soil contributes to protection. To solve potential problems, measures such as appeal, soil engineering, fork or intervention should be taken. In addition, flood protection and control of sediments are essential measures to alleviate damage. Therefore, it can be said that the initial stages of the study should consider establishing an extent of injuries and environmental damage. Therefore, depending on the level and situation of degradation, it may be necessary to take instant measures for emergencies, such as isolating the damaged sections, moving people affected and showing warning signs in these regions.

RECOVERY OF DEGRADED AREAS

The recovery of degraded areas involves a series of interdisciplinary techniques aimed at restoring ecosystems, recovering environmental functions and often reintegrating the panorama of socio-economic and cultural dynamics. Ecological restoration techniques are essential, taking into account revegetation and reforestation such as the use of native species adapted to the biome, the nucleation of creating “islands” of vegetation to accelerate the process of ecological succession; seeding the area through drones launching encapsulated seeds in a difficult access area is also an effective way to restore the area. Soil recovery with techniques of green fertilization and application of terracing steps on slopes to contain erosion (common in mining areas) and receiving Payment for Environmental Services (PES) to communities as financial incentives to preserve recovered areas. Planning the rehabilitation of degraded areas is important in which studies environmental issues play a role. Among these plans, there is the development of projects for the regeneration of the Earth, recognizing the site of excavation and dumping, preserving the forest sites, identifying the origin of pollution and its tests to

ensure resistance to landfills. Develop a soil test program to determine when interventions should be used to remove the soil; make a list of plant species and approaches to bring them back to the area; conduct an action plan that will help accelerate the renewal of the wild life population; ensure strict respect for all standards and criteria environmental. The processing of the plan is considered by the attributes of the restoration area as quality and conditions. Therefore, it is essential to establish monitoring systems that follow the quality of water (surface and ground water), air, soil, plant, animal life or biodiversity, in addition to structures and tools. There is degradation in cases where human activities or natural phenomena have a negative impact on the current and future capacity of ecosystems that support their resource base. In terms of restoration, it is a method of ecosystem recovery that is previously disturbed in its current state, where it may be useful for land use plans. Many people do not know how the mining industry affects ecosystems globally. It is impossible to understand how dangerous mining activities are, because there is no information concerning the subject. Figure 33 shows the relationship between the concepts of degradation, restoration, recovery and rehabilitation.

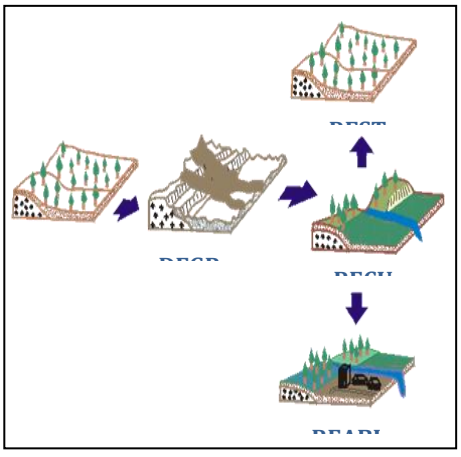

Figure 33–Relationship between the concepts of degradation, restoration, recovery and rehabilitation.

Source: Fornasari Filho and Amarantes (1989).

Ecosystem degradation causes the loss of soil fertility, native vegetation, and animal species and also reduces the potential for plant reproduction. This also affects the quality

and quantity of water available in the hydrological system. In addition, the resistance of plants is generally low because adaptation to the physical, chemical, or biological characteristics of the decomposed soil can be quite difficult for most plant species. The three main types of a degraded environment of the recovery process are shown in Figure 34, as reported by López-Findo (1998).

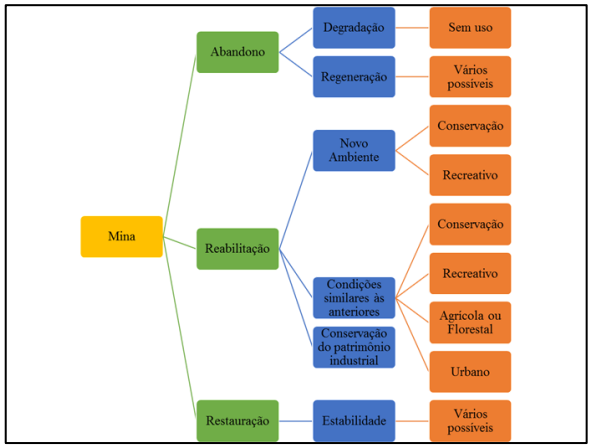

Figure 34–Stages of recovery of degraded areas and their potential uses.
Source: Sánchez (2008).

Restoration–is the reproduction of the exact conditions of the site, as they were before being altered by the intervention.

Rehabilitation–takes place on the altered site intended for a given form of land use, according to a prior project and in conditions compatible with the surrounding occupation, or in other words, it is about reusing the area for another purpose.

Recovery–the term recovery has been used generically to refer to restoration and rehabilitation.

MONITORING STRATEGIES AND TOOLS AND CHARACTERIZATION FOR ENVIRONMENTAL RECOVERY ASSESSMENT

Recovery indicates the use of techniques and steps to neutralize or remove chemical pollution in the environment, especially in soil and water. These measures, although they reduce the negative effects of pollution, they rarely eliminate them. In the case of degradation environmental caused by mineral extraction, efforts are focused on better

approaches for rehabilitation aimed at rehabilitating the affected areas. The strategies to cancel the negative effects of human activities on ecosystems are part of the renewal of rehabilitation and the environment. Soil metals contaminated can further influence metal contamination through properties that prevent the ability of plants to regenerate natural microorganisms or useful in the soil. This can lead to less vegetation, soil erosion and increased pollution by metal in other areas. Environmental efforts include the removal or treatment of contamination as part integral to the renewal process, while efforts to rehabilitate focus on attempts to restore ecosystems. A study with professional researchers in the environmental area, with experience in soil, hydrology, microbiologists, computers and statistical scientists is the key tothesuccessoftheimplementationofenvironmentalreconstructionprojects. The adequate development and implementation of the monitoring program also requires a good understanding of the physical, chemical and biological processes that occur in an area, along with a general understanding of the characteristics of the area. In the classification of observation, when it comes to environmental supervision, the columns are definitions of observation, sampling and measurement and their relationship in relation to scale. Today, the scientific and technological progress allows observations on a scale that varies from microscopic to global. An example of these types of observations can be seen in researchers who use subatomic particles to study atoms and molecules in compared to the different states of matter. In addition, orbit satellites can use sensors that allow you to copy the Earth's surface several times a day; however, these sensors can offer limited resolution in two or three dimensions. It can be a challenge to establish an observation scale. In this sense, an image satellite, for example, an important pool, because 100 km^2 with a resolution of 100 m^2 can confuse the effective extent of the extension. Time is also a factor and data environmental data are usually shown for the analysis that covers a specific period. The observation ladders are composed of time and space elements that help in contextualizing the measurement. A mixture of public, commercial, and private institutions collects, preserves, and examines environmental information. Governments, both local states, currently play a more important role in supervising environmental control and rehabilitation tasks, which include the implementation of the law and the regulations of large government agencies. For example, to ensure the duration of the law

on air quality and ground water protection, consistent data collection, the Arizona environmental department. Most of the pollution standards imposed by the agency come from federal regulations.

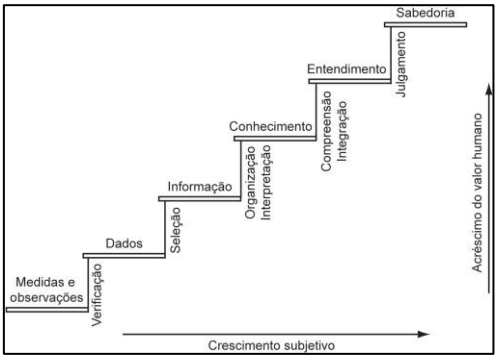

Figure 35–Environment measurement ladder.

Source: Artiolaetal. (2004).

CHAPTER XIV

GEOGRAPHIC INFORMATION SYSTEMS AND SENSOR APPLICATIONS-REMOTEMENT FOR ECOSYSTEM MANAGEMENT TO MONITORING IN THE STUDY AREA

Despite support for the establishment of protected areas, managers continue facing significant challenges in managing these areas. Territorial expansion, lack of qualified professionals, scarcity of resources and illegal activities are some of the obstacles they face. To overcome these difficulties, the CUs need tools and technologies that facilitate their control and supervision, such as geo references of the conflict and formation of the geo database. These measures allow effective CUs and rapid analysis. In general, define and understand the GIS is a challenge due to the different interpretations of GIS. GIS is considered a system computer, an organization of information and a tool to manage and form the form of data visualization and manipulation. They believe that GIS has two main features: 1-Integrate the data from the spatial folders into a unique database, including information geometric from various sources; and 2-Information on integers through resources technical that allow us to consult, analyze, retrieve, visualize and present content in the geo referential databases. In conservation, GIS can be used for

correlation and combine information from different sources in the real analysis. This is important because, unlike tickets traditional that remain static, the data can be updated and modified continuously. With GIS, it is possible to collect information from analytical topics, connect and create new maps of information and topics in the area without distorting the data. The geo database is one of the most important elements of GIS for allowing the update continuous data for space analysis. It sediting options are fundamental to the dynamic and adaptable nature of GIS, which allows the rapid regulation of information for accurate answers. Unlike traditional data bases that provide only geographic coordinates, the geo database allows you to assign each spatial view of the characteristics descriptive and classification. For this reason, GIS makes it extremely important for conservation and conservation applications quickly solve spatial problems. GIS can be used at different levels and solve various problems. The development of the GIS application can be divided in to three phases, from the implementation of actions to analytical applications that include the transition of data and statistical methods. The next step is called the use of management tools and corresponds to maximum use of GIS. At this stage, a deeper knowledge is needed and the application is limited. In the however, this usage model provides important support for decisions and currently problems future. As in other fields, GIS has more environmental applications at all levels. Since the 1990 s, GIS has been widely used in environmental activities throughout the country. Some important applications include: the processing and maintenance of tickets geographic; prevention and control of forest fires; morphological mapping of vegetation; search for areas subject to floods and landslides; monitor the urban development; exploration of the territorial behavior of animals; planning of water resources; control of forest diversion areas; monitor the phenomena of soil degradation; monitor the use and scope of precision mapping practices near of protected environmental areas; and complete studies in ecology. GIS shows the potential use of evaluating information from different sources geographically connected. GIS demonstrates its potential use by evaluating information from different sources that are geographically linked. From the analysis of diverse data that are spatially related, one of the possible applications of GIS is illustrated in Figure 36:

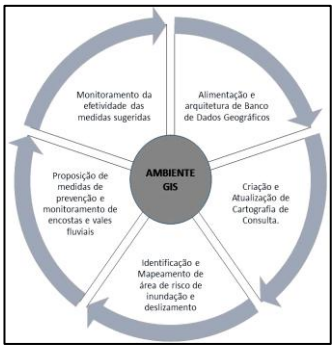

Figure 36–GIS as a central tool for analysis and landscape planning.
Source: Derven (2017).

As a potential solution to this challenge, geo processing stands out as a fundamentaltoolthatencompassesavarietyofgeospatialtechnologiesintheareaof GIS, such as remote sensing, Global Positioning System (GPS), geo databases, terrain and Web GIS. When integrated, these technologies can model and analyze computationally different environments, providing a broader view of spatial relationships. Advances in information technology have paved the way for the creation of new methods of processing cartographic data, facilitating the acquisition of information geospatial. New tools are constantly being created to collect and manage data, enabling the construction of databases with unlimited information. They assist in decision-making, providing a more unified approach to environmental management. This chapter discusses geo processing tools and how they can help manage PAs in the area in focus. Planning practices are fundamental to the management of PAs and include actions such as demarcation, inspection and preparation of management plans. The use of tools geo processing such as GPS and GIS makes demarcation activities faster and efficient. The delimitation of the PAs and their buffer zones can be done in the field by using GPS or geo referenced satellite images. This produces accurate maps and files that can be viewed in programs such as Google Earth and Quantum GIS. Inspections also benefit from the use of GIS to plan routes and determine the exact location of the areas to be inspected. With the help of GIS, the reported actions can be verified for compliance with the PA's zoning and, if there are violations, a inspector can be sent to the location. When developing management plans, geo data bases containing information on vegetation, fauna and risk areas can help improve accuracy and suitability of plans to meet local

realities. When a Geographic Database is maintained and updated regularly, it allows you to accurately identify the location of events or phenomena in space. This enables accurate responses according to the scale used in the analysis of spatial data. In addition, a Geographic Database facilitates the overlay of information from past activities with current ones and allows the visualization of different data from monitoring in a Preservation Area. Based on these assessments, it is evident that GI Soffers very useful resources for the management of Environmental Protection Areas. Therefore, it is recommended that managers and bodies governmental at the federal, state and municipal levels in the environmental area expand its application.

CHAPTER XV

ENVIRONMENTAL IMPACTS CAUSED BY KAOLIN EXTRACTION: THE CASE OF SERIDÓ POTIGUAR

Kaolin is a special clay-mineral used in the production of various products, including paper, porcelain, fertilizers and cosmetics. Although important to the economy and society, this can damage your environment. Reduce these influences, studies and environmental relations, including renovation plans. Companies must recognize the importance of protection environmental and follow environmental standards, such as ISO 9000 and 14,000. The mineral kaolin activity industry in Brazil is very important for the economy of the country. However, it is better to understand some technological and environmental aspects that are not yet have been completely explored. Most Caolina extraction studies focus in the exploration and extraction of minerals, neglecting important information about their chemical composition, applications, mining areas and negative environmental impacts. A complete general representation of kaolin must be carried out, from the study of deposits to the disposal of waste created and the measures proposed to all eviate these influences. The kaolin is mainly composed of the decomposition of feldspars. Sometimes it may contain minerals such as micas, manganese, quartz, tourmaline, among others. It is a safe in organic material that does not burn, is soluble in water, not tortured, neutral, and resistant to microorganisms and

variations of temperature. The shape and dimensions of kaolin particles are important for their use in paper, which affects properties such as viscosity, option, printing and sheets. Its specifications depend on the industrial purification process and the specific needs of each sector. Kaolin mining causes environmental changes due to waste, processing and transport. These activities have a physical and biological environmental impact, which leads to socio economic problems. The influences differ according to the type of mineral and the technology used, which requires special measures to restore the environment. Despite the growing environmental concerns, the kaolin industry is still facing problems with particle emissions from transport and production processes, as well as waste resulting that are converted into dust and dissemination of urban environments. According to the United Nations Study (1992), companies in urban areas are more responsible for these effects. Kaolin, also called "china clay" in the literature, is composed of the mineral (Al 2 O 3. MSi O 2. NH 2 O), abundant on the Earth's surface and one of the most industrial minerals important. In Brazil, it is found in sedimentary deposits or in pegmatites. About kaolin, Guerra (1972) states: Pure clay, white in color, resulting from the decomposition of feldspars by the effect of hydration. Kaolin is sometimes mined in pegmatite veins, forming material for the production of porcelain [...]. In the manufacture of fine ceramics, kaolin is an indispensable complement to feldspar. It is also consumed in the paper industry (GUERRA, 1972, p.88). Kaolin is a mineral used in the production of porcelain and ceramics for many years. Since the 20 th century, kaolin has also been used in the paper, plastic, pesticide, cosmetics, pharmaceuticals and various other industrial products industries. Currently, kaolin is found in many daily products and is widely used. However, some areas of Brazil still follow the country's tradition of research in a rudimentary way. The structure of kaolin is very important if used as paper filling and coating. Its properties, such as viscosity, opacity, primacy and sincerity, directly influence the size, distribution, structure and shape of the particles. The specifications for its use are based on industrial preparation or methods of purification and consider the specific physical and chemical characteristics of the sector in which they are used. Kaolin is widely used in ceramics, coatings, rubber, plastic, paper and other sectors. In Brazil, it is mainly used in the paper industry (53%), followed by coating dispersion (15%), production of rubber products (12%), refractory

(11%), ceramics (7%) and pesticide, fertilizer chemicals and other purposes. Export of Brazilian kaolin minerals is destined for different industrial sectors, mainly in the paper industry, where it is used for sincerity, fixing prints, coatings and fillers. For domestic consumption, kaolin is used in cement production and in the ceramics industry. The main companies that control kaolin production in the country are Vale and Imerys Idary, which produce high quality kaolin for the international market, in particular for the paper industry. Kaolin usually contains impurities and requires processing, which usually starts near the mine. The large mines in the North region are all open pit mines and underground extraction is mainly concentrated in Paraíba and Rio Grande do Norte. In addition, other states such as São Paulo, Minas Geraisand Rio Grande do Sulalso produce kaolin, making the Brazil one of the largest mineral producers and exporters in the world. Imerys Idary is one of the main producers of kaolin in São Paulo and operates in different countries. The company has the largest factory for the production of kaolin in the world, in Bacarena, Pará, with an annual production of 1.6 million tons. The extraction of kaolin begins with evaluation studies on the quantity and quality of the mineral, through the benefit and transport of waste. The extraction methods can be done by hand, semi-mechanized or fully automated and carried out externally, underground or in a mixed environment. Through the process, negative impacts on the physical, biological and human environment were identified. The environmental impacts vary according to the nature of the mineral and the method of extraction and processing, which require special measures to restore the environment. Despite the concerns of companies and environmental protection entities, the kaolin industry continues to face problems such as excessive particulate material during the transport of minerals and solid waste, which causes air pollution and affects the aesthetics of urban areas in which companies are found. Companies in urban areas are most affected in this regard. The degradation of the area is characterized when it is subjected to removal or destruction of vegetation and fauna: when the layer fertile soil is removed or oriented; when the quality and flow of the water system are carried out and when a loss of adjustment in the physical, chemical and biological characteristics occurs in the environment and, therefore, the immensity of socioeconomic development is observed (ÂNGELO, 1999). The dedicated soil is characterized by a presentation, in comparison with conditions natural, low organic and

nutritious substances, mainly carbon, nitrogen, phosphorus and sulfur, low and high water infiltration, with consequent biological activity of meso and micro fauna, which makes them unsuitable for good development of blankets of vegetation (RUIVO, 1998). The Environmental Degradation Force requires the search for alternatives to rehabilitation environmental, which include measures that promote from the deposition and decontamination of the environment, to the recommendation of nature in its fundamental elements. Therefore, what is suggested are measures that seek to mitigate negative short-term influences, which are certainly key elements in the case of sustainable development, which is an object of concern and effective action in all stages of sustainable development, this being the object of concern and effective actions in all phases of activity development mining (ÂNGELO, 1999). Dedicated areas are continuously created for various reasons. Awareness environmental to pressure its recovery, from cases where they are economically unproductive or considered permanent conservation, or as an open-air extraction area free (CARPANEZZI, 1990). The removal of vegetation, soil and underground layers leaves the landscape very degraded, causing negative influences. In the extraction of kaolin, there are other problems above all, because during the processing of minerals, liquid waste is created and thrown in rivers and solid waste is often buried. These wastes may contain abundances of metal, such as iron, aluminum, zinc and cadmium, in addition to other contaminations. The Photo 4 shows the total removal of the upper limit, exposing an anthrop.

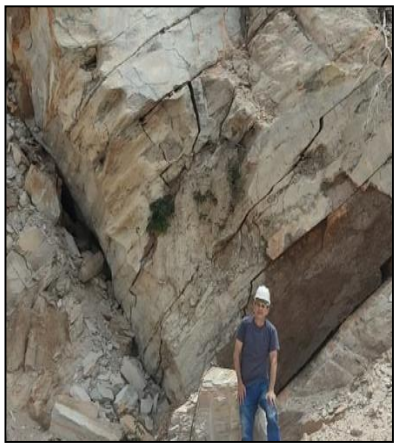

Photo 4 – Removal of the surrounding rock capping.

Source: Author's archive (2022).

The stripping in mineral extraction activities, which enables access to the mineralized body removed from the surrounding rock, is essential for the exposure, extraction, handling and transport of the ore. On the surface, one of the open-air stripping methods most used by mining companies is by benches, which consists of a process in which deposits are excavated in the form of benches. In this method, if the mineral deposit and capping are thin, only one bench may be sufficient. However, it will be necessary to develop more benches consecutively, according to the thickness and depth of the mineral deposit. In general, this extractive activity causes significant impact to the environment, as almost always the development of this activity implies the suppression of vegetation, the exposure of the soil to erosive processes with alterations in the quantity and quality of resources surface and underground water resources, in addition to causing other forms of pollution to the environment natural. When these elements are at levels above those permitted by law, their reflections frequently extrapolate the limits of the work areas, also reaching other places, the flora, the fauna, the hydric system and the morph physiological system of the soil (AUMOND; BALISTIERI,1997). Studies carried out in some rivers near kaolin processing companies and the analyses of points located at the effluent discharge of the industry and downstream of it show that, normally, these are quite contaminated with regard to the elements aluminum, iron and zinc. The contamination extends to samples of water, particulate matter, fluvial sediment and riparian vegetation (PEREIRA, 2000).

According to Photo 5, it can be seen that the natural landscape has been altered, with the vegetal suppression, being completely damaged and the soil capping being exhausted, also due to anthropic action and mineral extraction.

Photo 5–Suppression of the original vegetation of the Caatinga Biome.

Source: Author's archive(2022).

Considering the effects of mineral extraction and mineral extraction in the area where it concentrates this biome, the main and most characteristic influence caused by mining is that refers to the visual degradation of the landscape. The effects of environmental degradation can be summarized as follows: degradation and erosion of erosion (soil removal); sliding mass of earth/stone; land filling of valleys and waterways; the disappearance of the hill; visual pollution; suppression of flora. The open-pit mining company is generally different from most other geo technical engineering works. In this case, there is no insertion of a permanent element in the massif, which occurs in dam construction, but by continuous removal. Open extraction is nothing more than a large excavation of the soil surface, aiming to remove minerals metal and non-metal in any type of rock. Open cans can come from a small manual scraping on the soil surface to gigantic excavations that reach hundreds of deep meters, finally tens or even hundreds of square kilometers on the surface can occupy. The implementation of the Minas Gerais Company has immediate effects on the environment, within the limits of the mines themselves and in the surrounding areas. This is inevitable: the environmental balance ultimately affects a larger or smaller size. Therefore, all these actions that cause environmental impacts and according to relevant environmental legislation must be preceded. The main effects on the environment in the open-pit mine areas associated with dust, noise and vibrations and a greater suspension of solid particles in waterways and, in some mines, increase acidity during waterways in some mines. Figure 37 shows the visual contrast generated by mining activity.

Figure 37 – Visual contrast generated by mining activity.

Source: PINTEREST (2022).

The visual degradation of the landscape is one of the main impacts. It is caused by the removal of vegetation cover, the development of the open pit mine, the deployment of infrastructure (lodgings, offices, among others) and the disposal of solid and liquid waste. Generally, due to the extraction of ore and disposal of waste rock, there is an impact visual that can be softened with the adoption of some available techniques, such as: tree curtain: vegetation system that, if planted properly, confines the region mined and protects the environment from polluting factors related to dust and noise; banks: artificial bulkheads. In its construction, materials from the mine are used; such as the waste rock itself, which, when properly arranged, attenuates the aggressiveness of the landscape of the mining area; topographic profile: adaptation of the horizon line of the crest of the land from which it was extracted the ore, in order to harmonize it with the non-mined part. It is observed that most of the activities linked to mineral extraction cause great damage to the vegetation, which can impair its regeneration. In most cases, it is removed the superficial pedological horizon “A”, which has the largest amount of primary minerals, essential for good fertility rates. Horizons “B” and “C” are unprotected and susceptible to the action of erosive processes. From Figure 38, it is possible to perceive the characteristics of the pedological profiles of the horizons mentioned.

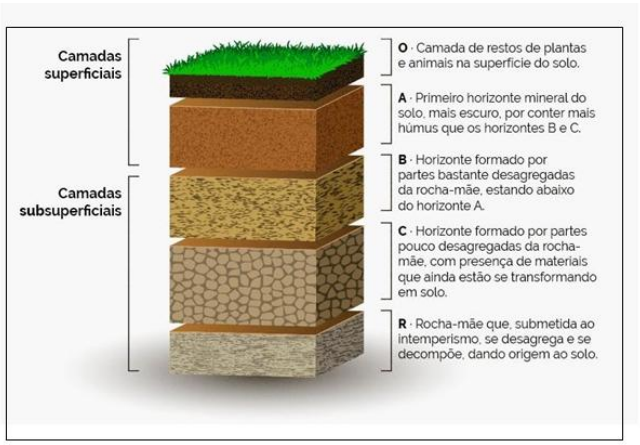

Figure 38–Soillayers.
Source: Ramiro (2019).

In addition to the negative impacts on vegetation cover, mineral exploration activity also causes siltation of water bodies, as well as damage to surrounding populations nearby. It

can also be seen that these activities cause air pollution by particles expelled during the processes of crushing and dismantling rocks, in addition to pollution caused by the burning of fuel from transport and heavy machinery in the service of activity. Exploration also causes, among other environmental impacts, changes in relief due to changes in the intensity of morphogenetic processes, which can form gullies and pits, generally associated with the intensification of surface run off, the reduction of infiltration due to the increase in slope, in addition to the removal of vegetation cover from the area of mining. Therefore, the combination of all these activities results in the mischaracterization geo morphological of the relief. Therefore, it is important to develop viable solutions to mitigate the environmental impacts promoted as a result of the extraction of this activity. Photo 6 shows the effect of vegetation and soil suppression in an area of the Caatinga Biome.

Photo 6–Vegetation and soil suppression.
Source: Author's archive (2022).

In the Equador–RN region and in other surrounding municipalities, the activity of mining is carried out on a large scale, using backhoe loaders that open huge mineral extraction galleries, notably on the slopes and top of hills and elevations of prominence in the region a topography. This activity may involve the participation of informal miners who pass on the raw kaolin to the processing industries. In this way, extraction becomes the main responsible for the modification of the landscape natural associated with the inadequate deposition of waste generated in the beneficiation processes of kaolin, in forest areas. Air

environmental pollution by particulates and deposition to along truck transport routes extends throughout the considered routes, up to the storage and processing locations. Although the kaolin production chain generates work and income, rudimentary extraction also puts workers 'health and safety at risk. The processes involving the extraction, transport, processing, and deposition of waste kaolin provide for easy dispersion of this material through the winds, since this mineral is characterized by being particulate and fine. Therefore, we can consider the wind as the main agent responsible for the horizontal dispersion of pollution in a given region. As seen in Photo 7, to reach the kaolin vein deposit, the surface coverings of the soil and surrounding rock are removed, causing a serious impact.

Photo 7 – Crater left after removal of the mineral vein.
Source: Author's archive (2022).

Previously, this material was extracted by artisanal mining activities, where they dug tunnels art is an a land opened shafts (vertical chimney openings) to remove the excavated material underground. Today, practically all of this activity is carried out using specialized machinery specialized machinery, which leads to a significant increase in the production chain and consequently, a greater environmental impact, with degraded areas requiring recovery throughout its cycle. Another form of environmental impact present in the area concerns the removal of vegetation from this biome, causing a desertification process, already observed in several articles and scientific research, constituting one of the nuclei in active and intense processes of desertification of the Brazilian space, with

this Caatinga Biome known as the Seridó Potiguar Nucleus. Through Photo 7, it is possible to verify that a good part of the geomorphological formation of the Serradas Queimadas, where we have the host rock of the Equador Quartzite, which traps the mineralized pegmatites, being impacted by the removal of the original caatinga vegetation, leaving this space bare in many stretches of this biome. Observing Photo 8, it is verified that the abundance of sterile material (gangue), deposited randomly near the mining companies. In addition to causing visual pollution, this material also causes a desertification process, making the soil infertile for small agricultural activities, causing, due to the acidity of this material, one of the processes of desertification in the studied area.

Photo 8 – Kaolin waste material deposited by mining companies.
Source: Author's archive (2022).

THE DESERTIFICATION PROCESS CAUSED BY ANTHROPIC ACTION

Today, with increasing environmental degradation and lack of planning and management environmental, it is important to understand the structure and design of the Brazilian landscape. Its objective is to highlight the importance of the ecological potential and limitations of the ecosystems of Earth. The Caatinga, in Brazil, is one of the most populous semi-arid regions in the world, with unique social and environmental characteristics, which are interconnected in complex ways and diverse. Small changes, such as water scarcity, can destabilize ecosystems entire. Therefore, the origin of three of the four desertification centers in the semi-arid regions of Brazil may be related to these changes. These nuclei are described as areas where vegetation and soil have degraded to

transform into small deserts that would form in a natural environment. Currently from environmental degradation and poor environmental planning and management, it is important to understand the structure and design of the Brazilian landscape. The ecological trends that Vasconcelos Sobrinho (1983) underlines require understanding the fact that desertification can result of "self-contained" situations. Therefore, human intervention is necessary to avoid the environmental deterioration, as this can become uncontrolled. The writer argues that vegetation cover plays an essential role in monitoring environmental aspects. Possible ways to analyze this issue include the use of field work and remote sensing. Studies show that different methodologies can be employed in the development of indicators. Oliveira-Galvão and Saito (2003) examined thematic maps of desertification in semi-arid regions of Brazil, with varying results. They highlighted the need for future studies and accurate mapping as methods for learn about susceptibility and detection of desertification in Brazil. The use of different environmental themes, instead of a simple analysis, is an alternative solution. For On the other hand, the drought index is one of the widely used indicators to assess vulnerability to desertification. Historical and Conceptual Aspects of Desertification the military engineer and naturalist Joãoda Costa Feijóluso-Brazilian, during the century XVII I obtained a significant role in the study and description related to the semi-arid regions of Brazil from Cape Verde, being a pioneering work when addressing the characteristics of the point of climatic, environmental and socioeconomic views of these areas, establishing correlations between the Brazilian Northeast hinter land and the archipelago of Cape Verde, where it also suffers from drought and aridity. The Portuguese Crown sent him to study the Northeast of Brazil, mainly in the Ceará Captaincy, describing the hinter land in detail, carrying out analysis of the fauna and flora with the challenges imposed by the drought. It also highlighted the difficulties of the local population, including the limitations for agriculture and live stock, due to the water scarcity. Through his observations, they helped to compose one of the first studies from a scientific point of view on the caatinga and the impacts of the semi-arid climate. Next, Joãoda Costa Feijó was sent to Cape Verde, a Portuguese colony, where the related problems were similar to those arising from the Brazilian Northeast, with the same characteristics, proposing measures to mitigate the effects concerning aridity, with adaptations of drought-resistant

crops and water conservation techniques. Through his in-depth scientific studies, he obtained a correlation between Brazil and Cape Verde, among the which he described that both suffered from a shortage of rain and soils considered poor, where there was a limitation of agricultural activity; he elaborated an identification of the flora and fauna, highlighting the resilience of semi-arid ecosystems and finally, contributed to the knowledge about the adaptation of local populations to adverse conditions, studies that today, still influences studies on sustainable development in the semi-arid region. Therefore, his work was fundamental to understanding the environmental and social dynamics of these regions, being considered one of the first scholars to describe scientifically the Brazilian semi-arid region. Desertification is a complex issue that has not yet been completely unraveled. The word implies several meanings and many times they are even contradictory or very ambiguous. Consequently, the reasons and results of this problem remain not well known. One of the topics of constant debates and disagreements is the definition, the very existence and the way to assess desertification. In carrying out studies, the selection of parameters that can be used in the analysis of this process is an obstacle. In the same perspective, we will focus on some key milestones in the conceptualization of desertification, as well as study peculiar or universal themes. The question is to discover which are the main things that define this phenomenon today. In this sense, the following periods and aspects standout, namely: Decades 1910/1930– Verstraete (1986) highlights the concept of "desiccation", as one of the first words found in the literature to refer specifically to what the referred authors perceived as a gradual drying of the climate, especially in the margins of the Sahara; 1940 s–The concept of desertification is introduced by the French botanist and ecologist Albert Abreuville, to highlight the process of forest degradation, intensification of erosive processes, drying of soils, changes in the physical and chemical properties of soils, and invasion of more xerophytic plant species (DREGNE,1987). Something that, according to Verstraete (1986) adds, Aubreville himself describes in 1947 as "bovalization", followed later, in 1949, by the terms "savannization" and "desertification". An attempt to describe a progressive transformation or replacement of tropical and subtropical forests in Africa by savannas (savannization) or into ecosystems even drier (desertification). It is noted, therefore, the use of this concept to describe the degradation processes throughout Africa,

including in the equatorial forests; 1950 s–The Arid Zones Research program, launched by UNESCO, for the knowledge and perception of the dry areas of the world, with the creation of the first encyclopedia of these regions. Equally interesting, Le Houérou (1977) introduces the term "desertization" to refer specifically to semi-desert areas bordering with real deserts. Something of great importance to desertification studies, in order to pay attention to this erroneous description in the ecological degradation in any type of environment, such as tropical forests that have nothing to do with deserts, physically or biologically (LE HOUÉROU, 1977); 1960 s–Important changes occur in rainfall patterns, with the occurrence of severe droughts in the African Sahel. So that, in association with the environmental degradation, a broader concept for the reality in question would then be necessary in order to describe the multiple aspects of the extensive disasters that followed – the concept of desertification; 1970 s–In response to the magnitude of the problems encountered in the Sahel, the United Nations General Assembly ordered the creation of United Nations Sudano- Saheliana Office (UNSO) and requested the United Nations Environment Programme (UNEP) to organize a United Nations Conference on Desertification (UNCOD). That way, still in the mid-1970 s, the Stockholm conference represents the first moment of global discussion of desertification, implemented later in Nairobi, Kenya, in 1977, with UNCOD(NASCIMENTO,2016). At that moment adopts a Plan of Action to Combat Desertification (PACD), which is understood as desertification being "the progressive degradation of the natural ecosystems of an area, resulting from natural factors or human action, and generally both in conjunction"; 1990 s–With the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, the need for the Intergovernmental Negotiating Committee(IN CD) to prepare a convention international to combat desertification. Officially, currently, according to the International Convention to Combat Desertification and Drought (UNCCD), the phenomenon of desertification can be conceptualized as "the process of land degradation in arid, semi-arid and dry sub-humid areas, resulting from various factors, including variations climatic and human activities". Regarding the official concept, Sampaio, Araújoand Sampaio (2008) make an interesting criticism by stating that the aforementioned definition is deliberately vague, when it comes to characterizing land degradation and the causal factors of the

phenomenon. In this case, according to the referred authors, the definition covers: [...] “various factors, including climatic variations and human activities”. “Various factors” leaves room for any land degradation, whatever its cause, to be considered desertification. “Climatic variations” is too undefined for a phenomenon that is variable by nature and without specifying the temporal and spatial scales. “Human activities”, without qualifications, is so broad that it encompasses all actions of humanity, in the present and in the past. There is no area in the world that has not suffered some human action, director indirect (SAMPAIO; ARAÚJO; SAMPAIO, 2008, p. 98). In this case, it seems that an ambiguous definition is involved. However, the document official that gives rise to this issue also describes soil degradation in detail and formally defines it as: [...] the reduction or loss of biological or economic productivity and complexity of rain fed agricultural land, irrigated agricultural land, natural pastures, sown pastures, forests and native forests due to land use systems or a process or combination of processes, including those resulting from human activity and their forms of occupation of the territory, such as: I) soil erosion caused by wind and/or water; II) the deterioration of the physical, chemical and biological or economic properties of the soil, and III) the destruction of vegetation for prolonged periods (SAMPAIO; ARAÚJO; SAMPAIO,2008, p.98). Sampaio, Araújo and Sampaio (2008) mention the need to pay attention to absence of clearly defined minimum scale criteria (spatial and temporal) that may be used for reliable estimation and assessment of degradation and desertification. The reduction or lack of biological productivity, economic productivity and diversity regional cannot continue to be sustained in definitely, as this is due to certain mechanisms. Information must be collected constantly so that the situation can be completely analyzed, because a single assessment will not be sufficient. According to Sampaio, Araújo and Sampaio (2008), when estimating desertification rates and investigating this phenomenon, a context with standard conditions taken into account must be identified. Although desertification, as a complex and controversial topic, has its origins in the expansion of the Sahara desert to the African Sahel region, it also takes into account the impacts of human activities. Verstraete (1986) states that it is appropriate to consider these terms interchangeable. To avoid misunderstandings, we will discuss and consider the following concepts related to this scenario as the basis of this study: Natural deserts – According to

Nascimento (2006), strictly speaking this concept cannot be confused with that of desertification, nor should the processes of degradation environmental in dry lands to the emergence of a desert biome. These environments had their extensions oscillated in the Quaternary period, with a general inclination to increase. In order to address the process of natural desertification of grasslands, steppes, and plains alluvial. For Verstraete (1986), the emphasis is on the geological time scale. It is, in our opinion, a climax biome with certain sustainability to which it imposes; Desertization – While Rubio (1998) reserves the vocabulary "desertization" exclusively to designate the natural processes of desert formation, "on scales geological time"(NASCIMENTO,2016). For Le Houérou(1977 citedby VASCONCELOS SOBRINHO, 1983), this is a process "induced by human action". Something still corroborated by Conti (2009), when designating the "extension of landscapes and forms typically desert, in semi-arid and sub-humid areas, as a consequence of the action human". For Verstraete (1986), the emphasis is on relief and vegetation; Desertification–According to the United Nations (1978), it is the decrease or destruction of the biological potential of the land, and can ultimately lead to desert conditions. It is an aspect of the wide spread deterioration of ecosystems, and has diminished or destroyed the biological production potential of the land, that is, plant and animal. It is, therefore, "a form of ecosystem degradation towards increasing environmental desiccation" (NIMER, 1988), dynamic and in processing that indies climax can be understood as "the reduction of the biological potential of the land" (VASCONCELOS SOBRINHO, 1983, p.3).

In short, it seems that desertification is caused by both natural forces and activities caused by man that put too much pressure on ecosystems with insufficient resilience. This can cause some land to turn into deserts or semi-desert conditions. Subsequently, the concept of desertification began to be used with two basic criteria: geographic space and duration of its occurrence. Processes such as decreased productivity are common in natural changes from arid to regions sub-humid. But there is no specific duration indicated in these definitions for these decreases. In addition to the periods and elements mentioned above, there are other factors and ideas that contribute to shaping the current reality. Worth considering are the processes of aridification, crypto desertification and xerophytic vegetation that characterize the pronounced environmental devastation of arid and semi-

arid lands. Similarly, it should be mentioned that there are other terms used to describe the opposite of the desertification process, including “aridification” and “oasization”. Alternatively, we can explore the disappearance of virgin desert ecosystems, caused by tourists with four-wheel drive cars causing damage extensive that make these parts impractical for tourism (NOWINSON, 1972). Causes, Processes and Consequences of the Desertification Phenomenon as mentioned by Ypersele and Verstraete (1986), understanding the reasons behind the desertification is a demanding task. The origin of the problem, according to Rodríguezetal. (2017), can be artificial and contradictory, because it can only cause behavior human or consequence of the interaction of natural and human factors. Furthermore, the desertification is not well defined as an official term and continues to be confused and incomplete. In his 1989 article, Conti (2009) identified two forms of desertification: climatic desertification and ecological desertification. Climate change can lead to a lack of water in ecosystems and influence natural systems that may derive from the effects of nature, human activities or a combination of both. Ecological desertification is due to population growth and human pressure that create the conditions observed in the desert. Based on the works of Le Houérou from 1977 and 2001, it can be concluded that the desertification is notable ways caused. These natural causes can change from types of vegetation decomposed due to irregular precipitation patterns. Some other terms are available to define the process of reverse desertification, such as “desertification” and “oasization”, which means extinction of the original desert ecosystems; Nowinson (1972), in his article “The tourism well and the excessive use of a four-wheel vehicle, turned the desert into an unpaid area.” As Ypersele and Verstraete (1986) suggest, the driving factors of desertification can be considered a complex problem. Rodríguez et al. (2017) they see this application as a presentation of many contradictory situations in its origin. The cause of desertification is exclusively anthropogenic or are there more human factors? Like each factor contributes to its interaction? Furthermore, the definitions that authorities give about the desertification are still ambiguous and incomplete. Conti (2009) described two types of desertification: climatic desertification and environmental desertification. Global warming may be one of the reasons why the ecosystem will suffer dry because it disrupts natural systems, probably due to causes natural or human activities. Ecological desertification is also the

result of a rapid increase in population and an increase in human pressure, with consequent situations similar to those of the desert. In the study, also based on Le Houérou (1977), desertification is occurring and naturally is the result of the degeneration of different types of vegetation due to the variability of rainfall. In the discussion of the evolution of this process, they underline factors geographical such as the location of the desert and tropical forest, the relative proximity between them and the effects on desertification. On the other hand, it is important to note that there are other concepts used to describe the turning point of a desertification process, such as “desertification” and “oasization”, or those words involved in the disappearance of the original ecosystems of the desert. Nowinson (1972) noted, as Verstraete (1986) mentioned that deserts do not became regional due to the degeneration caused by tourists and the excessive use of vehicles of four wheels. The causes of desertification can be difficult to attribute to climatic problems, because in recent times there have been no climate changes in the significant proportions in the semi-arid areas of the country. Therefore, it could hardly accept that environmental factors, such as dryness or dry, can cause desertification processes. Already an ecosystem, which are a predisposition to desertion (dry quality), will be more sensitive to inadequate occupation and will present the consequences of the process in a space shorter temporal. In Brazil, according to Nascimento (2016), desertification is not a problem because is not supported by the principles. However, the consequences of populated areas and the limited water supply are the main concerns, especially in the regions dry. Other scientists agree that desertification is largely caused by forces anthropogenic, such as live stock grazing, irrigation, mining and excessive cultivation, in addition to systems of land owner ship. Similarly, Oliveira-Galvão (2001) also stated that inadequate practices, such as exaggerated and forest degradation, cause environmental degradation and unsustainability of ecosystems. It is important to note that desertification can be understood after the influence of two paths between human activities and environmental conditions, with these phenomena at the beginning of the intrinsic vulnerable territory and, therefore, widespread in other parts due to the abuse of private resources of adequate management. This idea is supported by Sales (2002) when he states: The pressure of the population on natural resources, already naturally fragile, leads to environmental deterioration, generating a cycle of poverty and misery, making

the region increasingly vulnerable. Vulnerability in this case is the result of environmental, economic and social fragility, constituting an intricate feedback process. Pereira Neto and Fernandes (2015) shows that the Seridó prosthesis is also associated to environmental fragility. In addition, Nascimento (2016) suggests that, historically, the regions of dry countries are based on agriculture and livestock, which are not sustainable due to unfavorable climatic conditions that lead to environmental degradation caused by drying frequent. According to Goudie (1990), desertion can be attributed to human and climatic activity, with special emphasis on monoculture, overgrazing, salinization and deforestation. Furthermore these aspects, Nascimento (2016) explains that even precipitation models, patterns of life and levels of human pressure contribute to desertification, along with the measures that governments have taken to alleviate. Boluda, Carrasco and Oliveira (2008) say that desertification is also caused by social factors that communicate with the environment. Researchers are not consistent because desertification has occurred and Verstraete (1986) is requested that there is no origin of origin. Another scientist, Ab'Saber (1977), describes desertion as destroying landscapes and ecosystems as irreparable because, when one part, can never be replaced or even rehabilitated. Hareetal (1992), however, states that desertification refers to the reduction of biological activity overtime, eventually ending with vegetation and degradation of the soil. In short, desertification is a very complex issue that has factors caused by humans and climatic factors that contribute to it; it also has serious environmental consequences. The absence of an agreement on the origin makes it difficult to detect effective methods to be avoided. An important aspect that should be considered when solving the problem of desertification is the rate at which it occurs. For example, some scholars, Verstraete (1986) point out that the phrase “increase in desertification” (WINSTANLEY, 1976, LAMPREY, 1975) is also used. According to Perez-Marin and co-authors (2012), this analysis is quite complicated. Even if deep trenches are not made, there may be significant damage caused by erosion in the case of areas where rainfall is relatively low, but regular; Lamination of erosion in semi-arid areas can generally be rejected as it is not important for that area due to its special characteristics. The critical points of desertification are triggered by its dynamics and progress through herosion in the background. According to Sampaio, Araújoand Sampaio (2008), desertification is not a

universal fall model, but a set of regional variables: [...] the association and feedback, in time and space, of the triggering (causal) and resulting (effect) processes of desertification are considered to be mainly responsible for the potentiating of devastating effects of environmental degradation, in its multiple aspects. The convention considers the link between environmental degradation and desertification, with specific focus on the social effects of this process (SAMPAIO; ARAÚJO; SAMPAIO, 2008). They exhaustively expose the effects, highlighting that it is a gradual procedure that takes several steps: 1) land degradation in a specific area; 2) decrease in agricultural productivity in the area; 3) decrease in agricultural profit obtained by farmers and, in last analysis; 4) decline in the social conditions of local in habitants. In addition, environmental degradation can cause desertification, which is a disturbance of various components of the environment, as observed in Table 3, below.

Vegetação	Redução da biodiversidade (flora e fauna) e do patrimôniogenéticoregionalconsequênciadaeliminaçãodacoberturavegetaloriginal epresençada coberturainvasora.
Solos	Perdadosolopelosprocessoserosivosouprocessosquímicos(salinizaçãooualcalinização) ,acompanhadadoaumentodafrequência deredemoinhosetempestades deareia. Diminuição da fertilidade e produtividade do solo, queafetaaproduçãoagropecuária.
RecursosHídricos	Diminuição espaço-temporal da quantidade e qualidadedaságuasinterioresqueafetaprincipalmenteoescoamentosuperficial(quantidadeefrequência).
Socioeconômico	Na população humana: redução da qualidade de vida daspopulaçõesafetadas,comadiminuiçãodadensidadepopulacional, relacionado ao abandono de áreas improdutivas;aumentorelativodejovenseanciões,predomíniodosexofeminino em função da alta migração do sexo masculino (o queincrementaos cinturões depobreza). Nocomportamentosocioeconômico:diminuiçãodasfontes de ingresso e da relação entre produção e consumo:aocupação humana, que era basicamente primaria ou produtiva,passaa ser secundaria ouconsumista.

Table 3–Degradation processes related to the desertification process.
Source: Pereira Neto (2013).

Therefore, for Verstraete (1986) “the problem is that desertification is neither drought nor soil erosion, nor the destruction of vegetation cover, [...] nor even the degradation of living conditions: it is all that and much more”. Landscape eco dynamics and State of

Degradation in the Desertification Nucleus of Seridó/RN. The growing environmental degradation due to the exploitation of natural resources and population growth has made geography an important discipline. In this context, the concept of ecological landscape dynamics makes a valuable contribution to the analysis geographic. According to Conti (2009), the main objectives of these studies are to understand the organization, function and dynamics of landscapes, emphasize the importance of comprehensive analysis of landscape and discuss the impact of human actions. Ab'Saber (1969) also emphasized the importance of this topic: The most difficult sector of geographic research concerns the understanding of dynamics in process, that is, the study of the physiology of the landscape. Although the foundations of earth sciences have been based on the observation of current processes – understood as key to the interpretation of past processes. In this context, although it is important to characterize and analyze the environmental systems identified in the zoning and surface structure phases, the objective is to provide a understanding of current processes related to global ecological dynamics.

According to Tricart (1976) and Ross (1994), the concept of stability applies mainly to topography with regard to the flow of surface water and instabilities caused by erosive processes and other processes that involve some instability. Ecodynamic units associated with various degrees of stability/instability are, therefore, reflected in complex ways through the dynamic concepts in here tint he systems approach and the understanding of the natural environment (topography, climate, soils). Below are the ecological energy units and their potential, emerging, and environmental instability levels environmental: Potential instability of genetically stable areas–Tricart (1976) believed that stability referred primarily to the terrain and the interface between the atmosphere and the lithosphere. To classify a stable environment, the evolution of the relevant factors must be slow and continuous. The areas considered stable in the study include the Sertaneja Depression and subsystems of the Sertão Reserve. Where soils are deep and less susceptible to erosion, the caatinga vegetation can maintain the stability of the ecological dynamics. Furthermore, the soil in areas such as the Paleoplano do Maciço Formiga is clayey, making it less susceptible to erosion. The flat surface of the Cruzetasertão is also covered by dense clayey forests, favoring denser soils and greater plant diversity. These areas are less likely to experience natural erosion processes; Emerging instability and

degradation aspects in the Seridó potiguar–Damage environmental issues are increasing worldwide due to lack of planning and management territorial environmental. The removal or protection of vegetation may indicate more or less unstable. New areas of vulnerability are those where the dynamic balance is disturbed by human activities. Vegetation is an important indicator of stability environmental. The removal of vegetation cover can aggravate the erosion process. A human intervention can accelerate these processes. In the Seridó Potiguar core, the classification of vegetation cover and its degree of instability highlight areas with different degrees of vulnerability. According to Figure 39, below, the desertification centers of the Brazilian semi-arid region, in which the Seridó Potiguar is inserted, are observed.

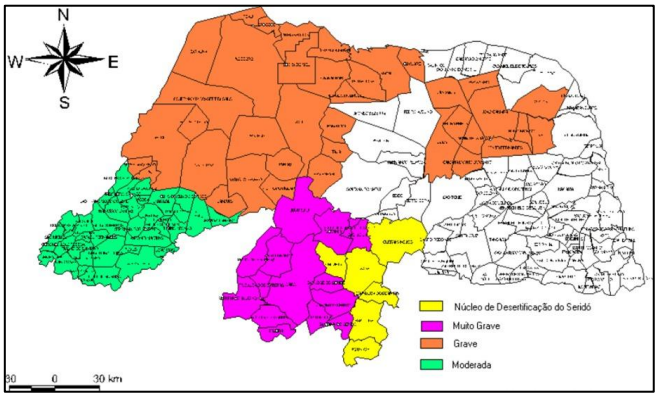

Figure 39–Characterization of desertification areas in Rio Grande do Norte.
Source: Carvalho, Gariglioand Barcellos (2000, p.9).

In this environment, there is intense deforestation activity to supply the furnaces of kaolin settling and tile and brick ceramics, causing serious damage to the Caatinga Biome of Seridó Potiguar. It can be seen, through Photo 9, a truck transporting firewood for these activities and in Photo 10, below, a settling furnace.

Photo 9 – Truck transporting firewood from daily cuts of the caatinga.
Source: Author's archive (2023).

Photo 10 – Kaolin kilns being fueled by firewood from the Caatinga Biome.
Source: Author's archive (2023).

The Seridó Desertification Nucleus identified by Duke (1953) in the 1950 s, who described Seridó as one of the most vulnerable and eroded areas in the Northeast. There were questions raised related to fires, deforestation, poor agricultural practices, removal of ceramic materials and intense mining. Tricart (1976) observed that natural causes contribute to the degradation caused by man, especially in degraded areas where environmental conditions make revegetation difficult. This instability affects soil erosion and biodiversity, accelerating the processes of degradation/desertification in the north eastern backlands. The area is very sensitive to erosion of a large scale due to environmental conditions and human activities. The geological and environmental relationships in the semi-arid regions of Brazil are complex and unstable and the balance of the natural environment is fragile, which leads to processes such as weathering, leaching and landslides, the worsening environmental deterioration.

CHAPTER XVI

FINAL CONSIDERATIONS

Throughout history, the concept of beauty and landscape has been redefined in each period, reflecting the values and priorities of each era. In Ancient Greece, beauty was not limited to aesthetic appearance, but was deeply linked to the ideals of truth and goodness. In the modern era, aesthetics has become established as a philosophical discipline dedicated to the study of beauty. From the 19 th century onwards, aesthetics came to be understood as an experience or perception, influenced by the knowledge and experiences of each individual. The perception aesthetics is, therefore, a form of interaction with the object that awakens feelings and sensations, shaped by the cultural and personal context of the observer. Beauty, in this sense, is defined by the aesthetic characteristics of the object that provide a pleasant experience to the observer. The protection of landscapes and natural resources gained relevance with the growing debate on environmental issues, leading to the creation of reserves and national parks. The beauty of the landscapes, especially those with theatrical or picturesque value, is appreciated not only for its visual uniqueness, but also for its connection with the culture and identity of the communities that inhabit them. The conservation of these landscapes is fundamental not only for guaranteeing the quality of life of people, but also to preserve the environment for the future generations. The evaluation of the visual qualities of a landscape can guide the planning territorial and the preservation of natural resources, since landscapes are spaces dynamic and heterogeneous, loaded with aesthetic and symbolic value, which influence well- being physical and psychological of people. In Brazil, the creation of protected areas was initially inspired by the North- American, with a focus on the protection of natural landscapes. Currently, there are several forms of protection of Brazilian landscape heritage, including areas of picturesque beauty. In the However, the country still lacks specific legislation for the protection of landscapes, although uses international tools and resources to advance in this direction. An example is the region of Seridó Potiguar, which has a rich and diverse landscape, but which needs protection and adequate management to guarantee its conservation and sustainable exploitation. The restoration of degraded areas, especially those affected by mining, has become a priority. Initially, the recovery

of these areas was seen as a simple restoration of the site to its original state. Today, however, renovation is understood as a planned process, which aims not only to correct environmental impacts, but also ensure long-term stability and sustainability. The objectives of the restoration include stabilizing the environment, making the soil compatible with the environmental and cultural conditions of the region, and promoting sustainable uses of the territory. The Brazilian Federal Constitution recognizes the importance of mining, but also emphasizes the need to rehabilitate degraded areas, seeking to balance activity economic with environmental protection. In the municipality of Equador, in Rio Grande do Norte, the extraction of kaolin generates waste that are disposed of outdoors, close to the city, in areas of exposed soil or in the vegetation of the caatinga, in addition to being close to bodies of water, which can contaminate resources natural. These wastes are not treated adequately, and although there are studies that propose its reuse in other sectors, these practices have not yet been implemented. In addition, there are abandoned mineral areas that lack environmental recovery plans, representing risks to the soil, to people and to animals that pass through these regions without knowing the dangers. Collaboration between the public and private sectors is essential to face these challenges. It is necessary to carryout accurate diagnoses, prevent and treat respiratory diseases, especially among mining workers, who often do not have adequate protective equipment or receive regular medical monitoring, which exposes them to diseases such as silicosis. Investments in technology and research are crucial to monitor air quality and the dispersion of particles from kaolin extraction, in addition to investigating the relationship between these particles and respiratory diseases in the region. In the context of Seridó Potiguar, desertification is a phenomenon accelerated by action human (anthropogenic) and aggravated by the instability of natural processes. According to Vasconcelos Sobrinho (1971), the government's first attitude must be to understand the environmental significance of the occupation of territories and act to prevent degradation. Desertification is a dynamic and complex process that can become self-accelerating if not controlled (HARE et al., 1992). Lack of adequate management and behavior inadequate human behavior further aggravate this process, especially in semi-arid regions like Seridó Potiguar. Understanding the complexity of desertification is a challenge that involves the analysis of the dynamics of geoecosystems in the semi-arid

regions of Brazil, as well as the socioeconomic characteristics of each area. Issues such as the nature of the problem, the factors involved, the appropriate indicators, and the reversibility of the process are fundamental to determine whether desertification is natural, caused by humans, or a combination of both, and whether it is possible to reverse its effects. In summary, the protection of landscapes, the restoration of degraded areas, and the fight against desertification require an integrated and sustainable approach, involving collaboration between governments, the private sector, and local communities. The search for a balance between development economic and environmental preservation is essential to ensure the quality of life for generations current and future.

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APPENDICES

ANNEXI–Impacts on human health resulting from silicosis in the mining/mineral processing environment

Another impact regarding mineral extraction concerns the emaciated human figures who contract silicosis and many succumb to this adversity. Silicosis is a fibro sing lung disease caused by the inhalation and deposition of crystalline silica particles, causing a reaction in the lungs. Although it can be prevented, it is a disease for which there is no specific treatment, and it can cause serious health problems for the worker. Pneumoconiosis is a term created to refer to the group of respiratory diseases resulting from the inhalation of mineral dust. Over time, the term has been adjusted to its own denominations that start from the name of the incriminated dust, such as, for example, silicosis (silica dust), asbestosis (asbestos dust), stannosis (tin dust). The term silicosis refers to the pulmonary reaction resulting from the inhalation of crystalline forms of free

silica (silicon dioxide, Si O 2), encompassing the chronic form of the disease, also called “classic” or “pure”, characterized by the presence of characteristic hyaline nodular lesions that, evolutionarily, can form extensive massive conglomerates, becoming progressive massive fibrosis, and the acute form, characterized by the development of alveolar protein sis and fibro sing alveolitis. Silicosis is one of the main human health problems related to mineral extraction activities and processing through small, medium and large mining companies, mainly in the grinding of feldspars and in the extraction and processing of kaolin. The objective of this chapter is to show, through research, the involvement of people involved in the extraction and processing of pegmatitic minerals from the Equador Formation. The methodology used was to verify in loco, and carryout research at the Municipal Secretariat in the records of patients in treatment for lung diseases. The main results were related to diseases, through the detection of silicosis. Among the main conclusions raised were the various health problems for the worker, causing inability to work after inhaling suspended silica, with their alveoli compromised. For this reason, throughout the process of this activity, the form of pneumoconiosis, caused by the inhalation of these fine crystalline silica particles, causes an inflammation in the form of nodular lesions in the upper pulmonary lobes, in this way, in its most advanced stage, causing respiratory difficulties, feverish state and cyanosis, and may be related to pulmonary edema, pneumonia or tuberculosis. Silicosis commonly affects miners, after years of inhaling silica present in the air of tunnels and galleries. Silica is deposited in the pulmonary alveoli, piercing cells and rupturing liposomes that spill

Their enzyme sand destroy the cells, an action known as autolysis and as a consequence the alveoli. According to the research and analysis of the workers involved in these activities, numerous diseases resulting from contact with micro particles of flint were detected. These pathologies are related to the extraction and processing of pegmatites, especially kaolin. According to those involved in this process, many are being affected in the lungs, causing a process of chronic inflammation with several harms to those involved in these activities, such as silicosis, lung disease, lung cancer, kidney disease and frequent tuberculosis. It is found that workers involved in these activities develop, in a period of 12 months, acute silicosis, characterized by a serious condition, with respiratory failure, being shown through radiographs the alveoli compromised and often

evolving to death. According to Figure 40, there is a significant advance in the condition of silicosis acute in some people involved in the context of mineral exploration in the region. You can observe the alveoli being filled with very small particles of silica, coming from the pegmatites extracted and processed in the mines and mining companies that process the material in their plants.

Figure 40–X-ray of a miner suffering from silicosis.
Source: Department of Health of Rio Grande do Norte (2019).

The most common process consists of simple chronic silicosis, with exposure above 12 years, beingmarkedbytheinitialphasewiththepresenceofmultiplenodulesinthelungs less than 1 cm and leading to nodular infiltration. The chest X-ray shows an asymptomatic degree, often causing a more severe symptomatic degree, occurring massive fibrosis, on set of dyspnea progressive and dry cough. Thus, the most prevalent pneumoconiosis is silicosis, characterized by silicotic nodules, which are the concentric layers of collagen shy alinized and brief ringent particles under polarized microscopy, and these nodules may cavitate, associated with tuberculosis or superimposed is chemia. It can be said that silicosis is a silent and fatal disease. The work carried out in the extraction of pegmatites, with the beneficiation mainly of kaolin, entail a series of lung diseases, mainly due to grinding and drying of the same, since the recommendation is that the material is always moist and not dry. It is also observed that Personal Protective Equipment (PPE) is not used by the workers involved in this activity, which compromises their health, since they could alleviate the initial situation, as shown in Photo 11, where we have an extraction of blocks of granites for lapidation.

Photo 11–Workers without PPE.
Source: Author's archive (2019).

In Photo 12, below we find a quartzite quartering process, where the worker, also for not using personal protective equipment, inhales directly suspended silica particles. These are residues that are generated in the form of shavings by the saws that cut these rocks and the dust that is expelled, is ingested directly by the people who do the work on site, clearly noticing the very fine dust on their faces, ears and especially nostrils, without any personal protective equipment, such as a mask, which would serve as an attenuate to contain part of this silica in suspension.

Photo 12 – Quartzite bench quartering with diamond saw.
Source: Author's archive (2022).

The results obtained in the present research showed a high rate of involvement of people involved, through the inhalation of suspended silica and activities of mining, or involved in kaolin mining and feldspar milling, according to Photo 13.

Photo 13 – Kaolin deposits with a high concentration of silica.
Source: Author's archive (2022).

Thus, a good part of those involved in these activities do not have equipment necessary for their protection, or the companies that employ them do not adopt or do not restrictions on those who do not use them, leaving the mat the mercy of the inclement conditions that involve them, resulting in the involvement of dust inhalations in suspensions formed by silicas, originating from the pegmatites of the region, these people being affected by chronic and irreversible pathologies. Those involved in these activities are predominantly all male, with some women in laboratory work and in other activities outside the production area. Silicosis can present itself in three distinct forms: acute, accelerated or chronic and its diagnosis is based on clinical and occupational history, associated with radiological findings compatible. To date, there is no specific treatment for silicosis that is effective and based on clinical trials, with the control of its complications being appropriate. A suggestion to reduce the number of patients with silicosis is prevention, through education in health and the use of PPE.