MOSAIC OF PROTECTED AREAS: A CONSERVATION STRATEGY FOR THE SERIDÓ POTIGUAR BIOME - BRAZIL

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ABSTRACT

Propose: The aim of this work is to show the Seridó Potiguar (Brazil) through the model of integrated management of conservation units and protected areas, known as area fragmentation mosaics.

Theoretical Frame of Reference: The loss of native vegetation, caused by anthropic destruction, is felt as one of the conditioning factors in the decrease of biodiversity almost everywhere on Earth, however, only with the creation of Conservation Units (UCs) will it be possible to establish a tool as a conservation strategy. From this perspective, the National System of Conservation Units (SNUC) has initiated the structure in mosaics, providing a participatory and social management of the territory, taking into account the conservation of biodiversity and geodiversity.

Method: The study of mosaics favors knowing the size of the distribution area by shallow cuts. Through this methodology, it is possible to know the depletion and/or rapid recovery of the APA protection scenario or fragmentation by deforestation. In this way, this article observes to what extent a good management of UC mosaics can cause a better contribution to the conservation of biodiversity and geodiversity, taking into account, particularly, the Caatinga biome in the Seridó of the state of Rio Grande do Norte.

Results and Discussion: As results, it was observed that the project presents biophysical, socioeconomic and environmental elements of the Seridó of Rio Grande do Norte.

Implications of the Research: There is no verification of studies of conservation mosaics in this region of Rio Grande do Norte, therefore a pioneer study.

Originality/Value: This research is unusual and original and will broaden the discussion of the Conservation Units in the Brazilian Northeast

Keywords: Mosaic, Conservation Unit, Protected Area, Protected Area, Environment.

MOSAICO DE UNIDADES DE CONSERVAÇÃO: UMA ESTRATÉGIA DE CONSERVAÇÃO PARA O BIOMA DO SERIDÓ POTIGUAR – BRASIL

RESUMO

Objetivo: O objetivo deste trabalho é mostrar o Seridó Potiguar (Brasil) através do modelo de gestão integrada das unidades de conservação e áreas protegidas, conhecido por mosaicos de fragmentação de área.

Referencial Teórico: A perda da vegetação nativa, ocasionada pela destruição antrópica, é sentida como um dos condicionantes na diminuição da biodiversidade em quase toda parte da Terra, porém, só com a criação de Unidades de Conservação (UCs) será possível estabelecer uma ferramenta como estratégia de conservação. Sob essa ótica, o Sistema Nacional de Unidades de Conservação (SNUC) iniciou a estrutura em mosaicos,

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proportionando uma gestão do território de forma participativa e social, levando-se em conta a conservação da biodiversidade e geodiversidade.

**Método:** O estudo de mosaicos privilegia conhecer o tamanho da área de distribuição por cortes rasos. Através desta metodologia, é possível conhecer o esgotamento e/ou a recuperação rápida do cenário de proteção APA ou a fragmentação por desmatamento. Dessa forma, neste artigo observa-se que uma boa gestão de mosaicos de UC pode ocasionar uma melhor contribuição para a conservação da biodiversidade e geodiversidade, levando-se em conta, particularmente, o bioma da Caatinga no Seridó do estado do Rio Grande do Norte.

**Resultados e Discussão:** Como resultados, observou-se que o projeto apresenta elementos biofísicos, socioeconômicos e ambientais do Seridó do Rio Grande do Norte.

**Implicações da Pesquisa:** Não há verificação de estudos de mosaicos de conservação nesta região do Rio Grande do Norte, portanto um estudo pioneiro.

**Originalidade/Valor:** Esta pesquisa é inusitada e original e ampliará a discussão das Unidades de Conservação no Nordeste brasileiro.

**Palavras-chave:** Mosaico, Unidade de Conservação, Área Protegida, Meio Ambiente.

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**1 INTRODUCTION**

Approximately 90% of the Earth's surface has already suffered or has been suffering some kind of human impact, from the Paleolithic period to the present day (Oliveira, 2021). In this sense, it can be observed that, as human populations continue with their migration cycle, a change occurs in the landscapes to satisfy their needs. There are interactions between natural processes and human activities to produce a constantly changing mosaic. In this way, terrestrial mosaics provide a spatial solution to meet the goals of land use for society, thus achieving a sustainable environment and protecting natural habitats.

It can be observed that this biodiversity presents, within a context, immense potential for the conservation of environmental and sustainable services, since, if well exploited in a sustainable development, they will be decisive for the maintenance of the balance of this geosystem. The Catinga biome of the Brazilian semi-arid is one of the most biodiverse in the world, exclusive to the Brazilian space, being one of the least known in Brazil. Combating the desertification process is associated with the conservation of the Catinga, it being noted that this process of environmental degradation takes place in arid, semi-arid and dry subhumid areas, occupying an area of 62% of the areas susceptible to the desertification process within this space, noting that many are already quite altered.

Occupying an extension of approximately 862,818 km², the space of the Brazilian Northeast represents 10.1% of the national territory, encompassing nine states and the north of Minas Gerais. In the Northeast, 27 million people live, with a good portion of its inhabitants dependent on natural resources to survive. Several biomes coexist simultaneously and show signs of dilapidation throughout the country's history.

As regards this picture, only about 9% of this biome is covered by UCs, with approximately 2% by full protection units, such as parks, biological reserves and ecological stations, since they are the most restrictive to human intervention.
In the ambit of the United Nations, in an international context, this biome is directly related to two of the three main environmental conventions, which are the Convention on Biological Diversity (CBD), the Convention to Combat Desertification (CCD) and the Convention on Climate Change (CMC).

The mosaics, among other conservation tools, are part of a historical evolution of the design of protected areas, which converges towards an integrated vision between environmental conservation and socio-cultural, politico-economic issues on a bioregional scale, highlighting the most participative processes of society.

The mosaic concept is related to what is called the management of nearby or juxtaposed UCs, which has the objective of stimulating an integrated management of the UCs, thus contributing to the preservation and conservation of natural resources, as well as to the sustainable development of the region, in agreement with the management bodies of the UCs. There is no clear international definition of this concept. Scientific texts describe landscaped mosaics, ecological corridors, or landscape corridors. It can also be said that a mosaic of UC is defined as being a model for the management of protected areas, in which it seeks the participation, integration and involvement of the managers of the units and of the local population in the management of them, having all this the objective of reconciling the presence of biodiversity, the valuing of social diversity and sustainable development in a regional context.

Law No. 9,985/2000, known as the National System of Conservation Units (SNUC) Law, states that the environmental mosaic institutes are inserted and positioned in this said law. Environmental science consists of living, including human, and non-living components within the ecosphere, constituting an interdependent character (Brazil, 2000). In this way, all the elements of ecological systems, composed of biotic, abiotic and anthropic means, are integrated within a geosystemic perception. In this context, this integrated management will assume an interdisciplinary profile, in which the so-called objects of the natural sciences, constituted by forests, soils, water resources, air, seek to satisfy fundamental human needs.

According to the SNUC Law, nearby, juxtaposed or overlapping UCs must be managed together, as a mosaic. In this sense, there will be a need for the creation of a joint mosaic council. Taking into account that there is a planning and administration within an integration with the other UCs, a potentialization of the role of these units was established through the SNUC. Thus, significant and ecologically viable samples of different ecosystems, populations and habitats will be adequately represented on national territory and in jurisdictional waters. To do so, the SNUC is managed by the three spheres of government (federal, state and municipal) (Brazil, 2000).

In the Brazilian space, according to the SNUC, there has been an institutionalization and normalization of protected areas - the Conservation Units - UCs (Brazil, 2000). Thus, only UC establishments will not be guarantees of preservation of an area, an ecosystem or a species (Tossulino et al., 2006). There is a need to improve conservation in existing UCs. Measures must be put into practice together, so that a UC must contribute from its conception to the conservation of nature and also to produce expressive results and stability of these UCs (Campos & Costa Filho, 2006).

Among the criteria that would be necessary for a UC to really contribute to conservation is the formation of mosaics from protected areas (Bennett & Mulongoy, 2006; Brazil, 2000; Davey & Phillips, 1998; Phillips, 2002; Thomas & Middleton, 2003). According to the SNUC, a mosaic is an area formed by a set of UCs of different categories of management or not, which are close, juxtaposed or overlapping and whose management must be done together, in order to make compatible, within a regional context, the conservation of biodiversity (Brazil, 2000).

The study of the landscape is a science in which the elements of the landscapes are treated, establishing themselves as an important tool, helping in the establishment of
conservation priorities, in the definition of new protection areas and in the management of protected areas (Milano, 1990). This designation "landscape" consists of a series of concepts between different authors, with different approaches attributed to them (Biondi, 2005). The landscape, therefore, is a heterogeneous area of land, possessing, in its composition, a grouping of ecosystems that are interlinked in a similar way.

Brazilian landscapes have been showing the multiplicity of uses accumulated over time, often resulting in very heterogeneous landscapes and generating major conflicts among social actors (Brito, 2003). These territories are relevant to environmental planning (Polette, 2003) because they are complex landscapes that are extremely fragile and must be strongly conserved, but they have numerous interests for human uses (Santos & Caldeyro, 2007).

The matrix, fragments and corridors consist of three spatial elements in which a landscape is structured, forming mosaics responsible for a diversification of landscapes, presenting spatial models with different components, which are elements of the natural framework, such as relief, lithology, climate, soil, water, vegetation and fauna (Forman, 1995; Marenzi, 2000), all these indicators above make up a negative consequence of anthropic action, that is, artificial components are inserted, coming from human influence (Biondi & Leal, 2002). According to the spatial patterns of the landscape, there is a discussion regarding the ecology of the landscape, as best ways of planning conservation areas for the protection of biological diversity, with the aim of understanding the composition of the structure of the landscapes in ecological processes (Metzger, 2003).

Accordingly, the different UCs made up of mosaics form landscapes that need an analysis of the concepts mentioned, and their structure translates the dynamics of cover and occupation of the soil, indispensable for their conservation. The maintenance of protected areas can be assessed through the structural elements of the landscapes, as well as the elaboration of management plans and conservation strategies, considering the mosaics of UCs not in an isolated manner, but within a focus of a UC.

The heterogeneity, which is rarely discrete in a given territory and stems from a wide range of habitats (Lovett et al., 2005) can be analyzed through the diversity of types and configuration of the elements that make up the landscape, the intensity of the interaction between those elements and the nature of the relationship between the elements (Mimra, 1993). It can also be observed by different types of pressure on natural fragments (Turner & Cardille, 2007), the porosity of the matrix (Couson et al., 1999) or by connectivity between elements (Li & Reynolds, 1995; Mcgarigal & Marks, 1995). It is important to note that one cannot directly relate the complexity of the landscape to the presence of impacts. De Pablo (2000) showed that certain landscape structures may or may not cause negative impacts, depending on the types and quantities of interactions between their elements.

In the Brazilian space, the expansion of the System of Conservation Units (SUC) is worrying, and it is estimated that the natural areas will be exhausted in a few decades, being indispensable the identification of strategies on a large scale that help in the maintenance of the system of remaining areas in a scenario of growing pressure. As strategies aimed at equating the alterations through which animal and plant communities pass, we can see the knowledge derived from studies in ecology and landscape management (Fonseca et al., 1997).

The use of remote sensing and geographic information system techniques is important in the study of the landscape, mainly due to its access and its adaptation (Forman, 1995), thus offering means for a quantitative analysis of the structure of the landscape.

The objective of this work is to verify, from the analysis of the structural elements of the landscape, the matrix and the fragments, as well as the spatial functionality of UCs of the biome of Seridó Potiguar. In this sense, integrated management takes on an interdisciplinary profile, in that it seeks to reconcile what has been the main object of the natural sciences with participatory processes of political decision-making, through popular participation. In these
processes of creating mosaics, the participants have encountered several problems and the mosaics run the risk of remaining only on paper and having the same fate as many UCs that are created but not implanted (Tambellini, 2007).

Based on these contributions, the Seridó Potiguar Region was chosen as a possible location for the creation of a UC mosaic. Therefore, the objective of this study is to propose the implementation of a mosaic in the biome of Seridó Potiguar in Rio Grande do Norte, based on the experiences of other studies already carried out on the theme. This research is an effort towards the analysis of the process of the implementation of mosaics in protected areas in Brazil, aiming to contribute to its effectiveness.

2 MATERIALS AND METHODS

Forecasts based on the theory of space use, using theories about fragmented environments (which are endowed with perfect knowledge and/or perfect location about the state of the landscape) follow assumptions based on empirical data about:

- (a) the size of the conservation area;
- (a) the size of the area of fragmented spaces.

The study of mosaics privileges knowing the size of the distribution area by shallow cuts. Through this methodology, it is possible to know the exhaustion and/or rapid recovery of the protection scenario - APA or fragmentation by deforestation.

As there was no information on the depletion rates of the Seridó, the satellite mapbiomas was used as a forecast of the degraded proportions, which includes the approach of comparing the regions of the old forest with the young forest nearby (a type of habitat with lower or less predictable maximum densities of prey).

2.1 Search Location

The largest continuous remaining portion of the biome of the Caatinga of the Northeast is located in the south of the state of Rio Grande do Norte, constituting itself in one of the nucleuses in the process of intense desertification in Brazil.

Firstly, a bibliographical survey and a documentary analysis were carried out from different sources (scientific articles, theses, dissertations, official websites, laws, decrees, among others), serving as a subsidy for the feasibility of the proposal for the creation of the Mosaic of UC do Seridó Potiguar in the state of Rio Grande do Norte.

From this preliminary analysis, one can see a lack of publications on the theme, in which it was possible to see that the majority of the works published address subjects such as organizational management (Silva et al., 2021), legislation (Machado, Costa, & Vilani, 2012), Brazilian mosaics (Maciel, 2007), ecological corridors (Lino, Albuquerque, & Dias, 2007) and UCs (Burkowski & Boas, 2014), however, very few addressed the mosaics of UC Protected areas (Campos, 2011; De Melo & Irving, 2014).

Seridó Potiguar is a geographical and cultural region belonging to the state of Rio Grande do Norte, as shown in Figure 1.
Figure 1 - Location of Seridó Potiguar.
Source: From the IBGE (2023).

Its territory covers the microregions of Seridó Oeste, Seridó Oriental and part of the microregion of the Açú Valley and Santana\(^3\) Mountain, as shown in Figure 2.

Figure 2 - Location of Seridó Potiguar.
Source: From the IBGE (2013).

The region possesses unique cultural and geographical characteristics when compared to other parts of the state, and it is highly sought after by tourism to appreciate the gastronomy of the place, its cultural events and for practicing extreme sports, besides also presenting the highest concentration of municipalities with high or medium-high Human Development Index (HDI) of the North and Northeast regions of the country. These characteristics were taken into account for the creation of the Seridó Geopark by the United Nations Educational, Scientific and Cultural Organization (UNESCO), which would reconcile development with environmental preservation and would have a significant impact on tourism.

From the geological point of view, the Seridó Potiguar is located in the Borborema Province, Rio Piranhas-Seridó Domain, its western portion being formed by a metamorphic paleoproterozoic foundation, corresponding to the Caicó Complex (ortogneisses and metavulcan sedimentary sequences), while in the eastern portion predominate supracrustal neoproterozoic rocks of the Seridó Group (gneisses, quartzites, schists, among others), also of metamorphic nature (Angelim, Medeiros, & Nesi, 2006). In this sense, for Angelim et al. (2006) the Exposed Crystalline Shield corresponds to the proterozoic crystalline terrain, in its vast majority metamorphic bands, involved in ancient orogenic events. It is the largest of the units that occur in Seridó Potiguar. Within this shield was discriminated a single Morfoescultural Unit, called Surface or Depression Sertaneja. This is an immense peripheral depression derived from the denudational processes, mainly pediplanation, that prevailed throughout the Quaternary.

Based on the analysis of geological information, planillymetric and digital elevation models, three Morphostructural Units were individualized in Seridó Potiguar, which are subdivided into four Morphocultural Units. The latter, in turn, are subdivided into six cultural Morphosccultural Subunits. These relief compartments and their respective nomenclatures can be seen in Figure 3.

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The East Northeast Atlantic watershed has an immense range of small and medium-sized dams that are used to store water used in agriculture and for human consumption. The Seridó River is a watercourse that bathes the states of the Northern County of Rio Grande do Norte. It is the main integral sub-basin of the catchment area of Piranhas-Açu. The neighboring areas of the basin are included in the grid of geographic coordinates 6°02' to 6°58' south latitude and 36°15' to 37°17' west longitude. Its basin comprises 17 municipalities. Its source is located in the foothills of the Serra dos Cariris or Serra do Alagamar, in the municipality of Cubati. Still in Paraíba, the River Seridó is dammed in the municipality of the same name and, for a long time, was the source of supply of the city of São Vicente do Seridó. Just after the flooding season, when the river overflows the reservoir, natural pools are formed in Serra Branca, which is located in the municipality of Seridó, close to the border between the municipalities of Pedra Lavrada and Parelhas. It then penetrates the Rio Grande do Sul territory through the municipality of Parelhas, where it is dammed, forming the Barragem Boqueirão. Then, its bed runs through the municipalities of Jardim do Seridó, São José do Seridó, Caicó and São Fernando, in this last one, about four leagues north of the municipality, the river flows into the Piranhas River. The Geomorphologic Map of the Seridó/PB River Basin is identified through Figure 4.
With regard to climate, the region is divided into three homogeneous areas. The dry humid climate, or mild semi-arid, extends from the municipality of Caicó to the municipality of Serra Negra do Norte, with rainfall ranging from 800 to 1000 millimeters per year and average annual temperature in the region of 27.5°C. In the other region, the climate occurs as a medium semi-arid, with rainfall ranging from 600 to 800 mm annually and average temperature of 26°C. In the other areas of Eastern Seridó, the climate is defined as a rigorous semi-arid, with rainfall ranging from 400 to 600 mm/year and milder temperatures due to altitude, with temperatures that can reach 10°C minimum in winter and 30°C maximum in summer. These characteristics are being taken into account for the creation of the Seridó Geopark, of UNESCO, which would reconcile development with environmental preservation and would have a significant impact on tourism (Santos & García, 2017; IBGE, 2018; UNESCO, 2014).

Taking into account the fragments and the matrix, as well as their attributes and their interrelations, the legal aspects of the total area of this UC, when they are analyzed, it will be possible to measure their functionality in the biome of the Caatinga of the Seridó Potiguar.

3 RESULTS AND DISCUSSION

Conservation units protect the natural resources that are essential to many people on Earth. Within these areas, the genetic diversity of the biome can evolve in response to pressures of natural selection (Matos & Serra, 2020). The preservation of natural areas offers many practical benefits. For example, natural areas contain the biological raw material needed for the development of products that can greatly benefit human health, diversity and genetic well-being (Grise, 2013).

In addition, they provide safe havens for endangered species, store carbon, generate much of our clean air and water, house sites of cultural and spiritual importance, and support

Figure 4 - Geomorphologic map - River Seridó River basin.
Source: Rabelo (2016)
the livelihoods of millions of people. Protected areas have a critical role to play in tackling the global nature crisis (Honora, 2018; Duarte, 2012).

Rio Grande do Norte is one of the states that has not yet been contemplated with the method of Rapid Assessment and Prioritization of Protected Area Management (RAPPAM). Therefore, it is indispensable to apply RAPPAM to identify weaknesses and strengths in the implementation of the Potiguar UC System. The weaknesses of the Potiguar UC System are mainly reflected in the lack of investment in human, financial and research resources, in the lack of application of the principles of sustainability in the use of resources, and in the low social and political commitment to maintain a system of connected protected areas. However, it finds potential at the moment when it has an operational planning, covering both social and economic and environmental values, which is optimized with the implementation of a good physical infrastructure of the UC, ease of communication between the different social actors involved in the management and the community participation represented by the management boards (Teixeira & Venticinque, 2014).

Destruction and modification of habitats are inherent consequences of activities related to anthropic occupation (Burkowski & Boas, 2014). The results obtained indicate that areas subject to anthropic activities, although disturbed, may be very important for the preservation of biomes (Domenico, 2008). Therefore, intensive field studies are fundamental, as are the improvement and standardization of methods and techniques.

The mosaics should be supported by the advisory councils, which should act as an integrated management body for the UCs. The strengthening of Ecological Corridors and the creation of Mosaics of UCs and protected areas were defined in the Strategic Planning of the Atlantic Forest Biosphere Reserve as a priority line of conservation, which presupposes the consolidation, strengthening and creation of UCs and their management instruments, in a vision of articulation between them and their surroundings (Lino, Albuquerque, & Dias, 2007).

Law n° 9.985 of 2000, known as the SNUC Law, is the legal instrument that provides for the implementation and management of UCs in Brazil, establishing the National System of UCs. According to this law, UC is:

Territorial space and its environmental resources, including jurisdictional waters, with relevant natural characteristics, legally established by the Public Authority, with defined conservation objectives and limits, under special administration regime, to which they apply appropriate guarantees of protection (Brazil, 2000, p.28)

Another positive factor as far as the creation of the SNUC law is concerned with the fact that it brings to the sphere of a single normative instrument practically all of the dynamics of the creation and management of UCs in Brazil. It is also worth pointing out that, in spite of the advances, some considerations must be made. Many specially protected territorial spaces, which are of paramount importance for the effective guarantee of the functioning of the system, are not mentioned in the SNUC, as indigenous and quilombo lands, legal reserves, environmental protection areas (APAs), areas of special tourist interest, caves, among others (Scalco & Gontijo, 2009).

Discussions on the environmental issue and the importance of preserving and conserving certain areas, which are becoming increasingly frequent in the various social spaces, show the exacerbated exploitation of natural resources as an activity that needs to be controlled (Campos, 2011). Furthermore, this type of knowledge could provide concrete information for the development of effective conservation measures.

According to Tambellini (2007), environmental governance is intrinsically linked to issues of spatial planning and sustainable development. For the author, a differentiated project
of development for a given "place" or "region" unleashes a new way of thinking about the appropriation of the territory and of its resources.

In this view, it is observed that the dizzying growth of human populations is causing high environmental wear and tear and, consequently, resulting in a considerable loss of biological diversity due to the irreversible extinctions of species, caused by the destruction of their natural habitats (CAMPOS, 2011).

There is therefore an urgent need to create projects and programs aimed at reducing these impacts with a view to environmental degradation. In this sense, the implementation of mosaics in UCs and protected areas is a good solution.

According to Figure 5, of land use and occupation extracted from Mapbiomas (2023), it is observed that this mosaic of vegetation and land use was still little explored, occupying a considerable percentage of dense and sparse vegetation in its space, with few areas of pasture.

![Figure 5 - Map of land use and occupation of Seridó Potiguar](image)

**Source:** Authors from Mapbiomas (2023).

After a space of about 15 years, agricultural activities have intensified in the north of this region, mainly close to the Serra do Doctor, where soil conditions are more favorable to these activities, noting that there is already a decrease in the dense vegetation of the caatinga and a small increase in the pastures, exposing the soil, with the introduction of small creators. Such changes can be seen in Figure 6 below.
After another 15 years, it can be seen that this area is already undergoing significant changes, pointing to an increase in small agricultural and farming activities, with much of its soil becoming bare, mainly as a result of the extraction of wood to serve the activities of ceramists and furnaces of kaolin decantations, more specifically in the municipalities of Carnaúba dos Dantas, Parelhas and Ecuador. The above changes are well defined in Figure 7 below.
In 2021, this biome is already with a significant alteration in almost all of its space, observing that due to the agricultural expansion, farming and intensification of mineral extraction activities, this fragile biome of the Caatinga of Seridó Potiguar has been suffering a significant impact in its natural environment, mainly, becoming an intense core in desertification process before the United Nations (UN).
Rêgo (2012) attributes to three strands the beginning of the discussions. Firstly, the Frenchman Louis Lavaudeu reportedly, in 1927, reported in an article on the impoverishment of the groves of southern Tunisia, stating that desertification was a process of anthropic provenance. Another Frenchman, André Aubréville, would have, in 1949, in the book "Climats, Forêts et Desérrificaion de l’Afrique tropicale", characterized the replacement of the tropical forests and subtropical forests by savannas, understanding that the process of degradation was the fruit of the predatory use of resources. The third strand credits the US studies on desertification, to the degradation processes that have taken place 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 the soils by agriculture and cattle raising, aggravated by a strong drought between 1929 and 1932, would have caused the phenomenon of dust storms known as the "Dust Bowl".

According to Figure 9, the desertification nuclei of the Brazilian semi-arid region, in which Seridó Potiguar is inserted, are observed.
4 FINAL CONSIDERATIONS

Participation and integrated management are considered sufficient to ensure preservation and conservation. What is required to ensure integrated management across UC tiles? Are participation and integrated management sufficient to ensure conservation of biodiversity in mosaics? The owners of the areas between the UCs can have access to the Boards managing the mosaics, but how to guarantee that they have effective participation? These are questions that are intended to be answered with a view to a proposal for the implantation of a mosaic of UC in the Seridó Potiguar.

UCs or protected areas help mitigate extreme weather events, increase carbon storage and provide space for plants and animals to adapt to a changing climate, to keep ecosystems functioning and the benefits they provide. The protected areas provide air and clean water, healthy soils, wildlife food and medicines.

However, in order to understand the landscape, it is necessary to deal with broad spatial and temporal scales, since man acts on wide expanses of his territory. With the analysis of these interactive sets and their limits, one recognizes the existence of a spatial dependency between the units of the landscape.

It follows that, in order to reconcile land use and environmental, social and economic sustainability, it is necessary to plan the occupation and conservation of the landscape as a whole. To do so, the integrated way of looking at the landscape, as a mosaic, facilitates the understanding of the structural modifications, therefore functional, brought by man in the mosaic as a whole, incorporating, in an explicit manner, all the complexity of the spatial interrelations of its components, both natural and cultural.
REFERENCES


Biondi, D., & Leal, C. T. Analysis of the landscape capacity of the Vila Velha State Park - PR. In *the Brazilian Congress of Conservation Units*. (pp. 359-367). Fortress, CE.


De Pablo, C. L. (2000). Ecological mapping: concepts and procedures fora *Boletín de la Real Sociedad Española de Historia Natural*, 96(2), 57-68.


Fonseca, G. A. B., Pinto, L. P. Biodiversity and Units of Conservation. In *the Brazilian Congress of Conservation Units*. (pp. 262-185). Curitiba, PR.


Marenzi, R. C. Ecology of the landscape as an instrument of support (2000). In the Brazilian Congress of Conservation Units. (pp. 22-31). Campo Grande, MS.


