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Geological structures as elements facilitating connectivity between Caatinga

Estruturas geológicas como elementos facilitadores de conectividade entre fragmentos de Caatinga

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Abstract: The Caatinga is an endemic Brazilian biome that stands out for its geodiversity and biodiversity adapted to the semiarid climate. These peculiarities have historically been overlooked by public policies and scientific studies, and the conventional wisdom still holds as a region of extreme social and landscape poverty. The alteration of vegetation to anthropogenic subsistence uses threatens the remaining Caatinga regions, which are more isolated from each other. The Caatinga patches of the Cariri region in Paraíba were analyzed from a perspective novel to the area, with the aim of evaluating geoenvironmental components and modeling the structural connectivity of the Caatinga based on the geographic premises of Landscape Ecology. The resulting modeling, using the Integral Connectivity Index, highlighted the alarming isolation of Dense Caatinga patches. Given the identified environmental degradation, lineaments of topographic heights and shear zones become facilitators for the formation of ecological corridors, based on fractal theory, where geomorphological features of residual reliefs are repeated at the regional scale. Thus, it was concluded that analogous geoenvironmental components can be incorporated as strategies into territorial planning to connect areas relevant to the biome's environmental preservation.

Keywords: srtuctural connectivity; Caatinga patches; territorial planning.

Resumo: A Caatinga é um bioma endêmico do Brasil que se destaca pela geodiversidade e biodiversidade adaptada ao clima semiárido. Tais peculiaridades foram historicamente negligenciadas por políticas públicas e estudos científicos, sendo ainda mantido o senso comum de uma região com extrema pobreza social e paisagística. A perda da vegetação nativa para usos antropogênicos de subsistência ameaça os remanescentes de Caatinga, que estão mais isolados entre si. Os fragmentos de Caatinga do Cariri Paraibano foram analisados sob uma perspectiva inédita na região, com o objetivo de avaliar os componentes geoambientais e modelar a conectividade estrutural da Caatinga conforme premissa geográfica da Ecologia de Paisagem. A modelagem do Índice Integral de Conectividade evidenciou o cenário alarmante do isolamento dos fragmentos de Caatinga Densa. Diante da degradação ambiental identificada, lineamentos de altos topográficos e zonas de cisalhamento demonstraram ser elementos facilitadores para a formação de corredores estruturais, embasados na teoria dos fractais, onde feições geomorfológicas dos relevos residuais se repetem na escala regional. Desta forma, componentes geoambientais análogos podem ser incorporados como estratégias ao planejamento territorial para conectar áreas relevantes na preservação ambiental do bioma.

Palavras-chave: conectividade estrutural; fragmentos de Caatinga; planejamento territorial.

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1. Introduction

The Caatinga is the largest Seasonally Dry Tropical Forest in South America, covering great part of the Brazilian Northeast and a small portion of the state of Minas Gerais. The endemic biome covers about 10% of the Brazilian territory, where semi-arid climate predominates. It is characterized by herbaceous, shrubby and arboreous vegetation, with dominance of xerophytic and deciduous species, and is formed by the geographical arrangement of historical, climatic, biotic and abiotic elements (LESSA et al., 2019; LIMA et al., 2018; MEIADO et al.; 2020; SANTOS et al., 2011; SOUZA et al. (2015).

According to Silva e Souza (2018) and Lima et al. (2018), there are several non-exclusive hypotheses to explain the diversification patterns of such rich, high Neotropical biodiversity. Moro et al. (2015) state that the Caatinga plants have developed adaptive ecological strategies due to the semi-arid water stress, resulting in a high floral biodiversity associated to edaphic environments. Another hypothesis is related to tectonic events occurred in the Paleocene (66-56 Ma), with the paleogeographic reorganization maintained by the climate changes of the Pleistocene (1,58-0,00117 Ma). Such historical dynamics enable the expansion and retraction of the tropical forests, with the advance of species from open and dry forest formations through the corridors of the Pleistocene xeric refuges (SILVA; SOUZA, 2018).

Endogenous and exogenous factors also support the understanding of the evolution of an important geological structure in the Brazilian Northeast, in which the Caatinga manifests: the Borborema Province. Classical models about the morphostructural development of Borborema emphasize climatic-erosional aspects, whose morphogenesis results from post-cretaceous epirogenic processes and successive planation cycles. However, they do not explain the set of geo-morphological landscapes observed in the region (CORREA et al., 2010; MAIA; BEZERRA; SALES, 2010).

In the Borborema Plateau, the typical presence of inselbergs, rock slabs and plutons in granitic areas have topographic features associated with weathering and denudation resulting from the Brazilian orogeny, with a geodynamic cycle marked by the development of directional shearing zones associated to an extensive Ediacarian magmatism (MAIA; NASCIMENTO, 2018; LAGES et al., 2016). Correa et al. (2010) point out that the influence of the inherited structures, the lithology about the differential erosion models and the occurrence of a regional uplift from the Cretaceous are morphostructural premises that support the research about the morphogenesis of this important relief unit in the Brazilian northeast.

With landscapes undergoing pediplanation, the elevated surfaces in the Borborema stand out and develop an important orographic control, as they retain moisture at the highest crests and windward slopes of the winds coming from the Atlantic and help reduce moisture on the leeward slopes (MEIADO et al., 2020). Maia and Nascimento (2018) complement that the compartments and traits of the relief also organize an important drainage system. According to the authors, in the dissolution basins, several erosional recesses confine ephemeral drainage channels, either isolated or interconnected by outlets; and the grooves originate radial drainage outlets with possible accumulation of sediments and organic matter within, which enables vegetation cover on the surfaces of inselbergs and granitic blocks.

In spite of those Caatinga specific features, Santos et al. (2011) state that there are not enough studies about the biome when compared to humid forests. According to the authors, the absence of scientific information stood out in the 1990s, which compromised public investments and policies turned at the sustainable development in the region. Currently, studies and public policies are still considered incipient in the Caatinga, which is highly threatened by the high levels of desertification and low representation of the protected areas. Those comprise only 9% of the ecosystem (LESSA et al., 2019; MEIADO et al., 2020; MORO et al., 2015; SOUZA et al., 2015).

Landscape Ecology has allowed understanding the fragmentation of habitats, and through modeling, assessing the configuration, composition and dynamics of heterogenous mosaics in an observation scale (METZGER et al., 2007). In this sense, Pomianowski and Solon (2020) highlight how a more promising approach, in which habitat spots (node sets) are distinguished from the matrix; and the connections (edges) represent the distance between the spots. According to Herrmann (2011), the application of a landscape connection system is a premise for the formation of ecological corridors, which are considered efficient instruments for regional planning, capable of integrating mosaics and enabling the resilience of modified landscapes.

The term “ecological corridor” is defined by the Brazilian System of Conservation Units (SNUC in the Portuguese acronym) as portions of natural or semi-natural ecosystems that connects two or more Conservation Units (UC) and aims at facilitating the recolonization of degraded areas, the dispersion of species, and the maintenance of populations of species that require extensive areas to survive. Thus, the connectivity can be functional, based on the displacement of individuals and populations; or structural, based on the occurrence, spatial distribution and relations between vegetation patches

associated with physical features of the landscape (PEREIRA; CESTARO, 2016; POMIANOWSKI; SOLON, 2020; ZOILKOWSKA et al., 2014).

In that perspective, this study presents an analysis under the geographical point of view of Landscape Ecology and aims at identifying potential areas for the structural connectivity in the Caatinga, with focus on the region of Paraíba's Cariri.

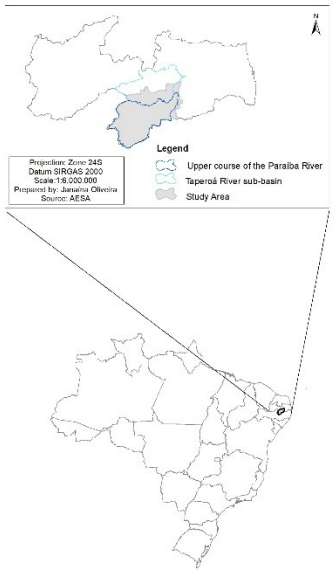
2. Methodology

The study area was defined to contemplate the upper Paraíba River basin and part of the Taperoá River sub-basin. In addition to the hydric relevance, these areas shelter important residual massifs with unique geodiversity and biodiversity. With 920,771 hectares, the area includes 21 municipalities of the Paraíba's Cariri and a population of 146,194 inhabitants (IBGE, 2022), mostly composed of small-scale farmers that survive despite seasonal climate and hydrological variations.

The Borborema plateau influences the climate in the region, which is hot semi-arid BSh according to the Köppen classification, presenting the lowest rainfall in Brazil, with an average rainfall between 400 and 800 mm. In spite of the low rainfall, Souza et al (2015) highlight the Paraíba's Cariri region for the high level of anthropogenic disturbance, with loss of vegetation and large desertification areas, threatening the rich diversity of plant species associated with the region's crystalline complex .

Farming practices, subsistence included, contribute to the local degradation. The expressive quantity of goats is shown in the Agricultural Census by IBGE, with 235,947 heads in 2017. The animals are well adapted to the local conditions and are capable of using native vegetation areas for grazing, and are easily viewed in the studied region, including in areas with higher elevation.

In addition to the anthropogenic activities, instruments for conserving areas with relevant natural characteristics are still scarce. These are represented by four UCs for Sustainable Use, totaling 6.53% of the region. The interest in geoconservation is marked by the proposal of the Brazilian Geological Service to create the Paraíba's Cariri Geopark (LAGES et al., 2018). Nine geodiversity sites (with potential educational and touristic use) and 11 geosites (determined by representativeness, integrity, rareness, and scientific knowledge of national and international relevance). The proposal covers 21% of the study area. If implanted, it can contribute to the local preservation, although it does not have legal standing to protect the identified geological heritage (Figure 1)



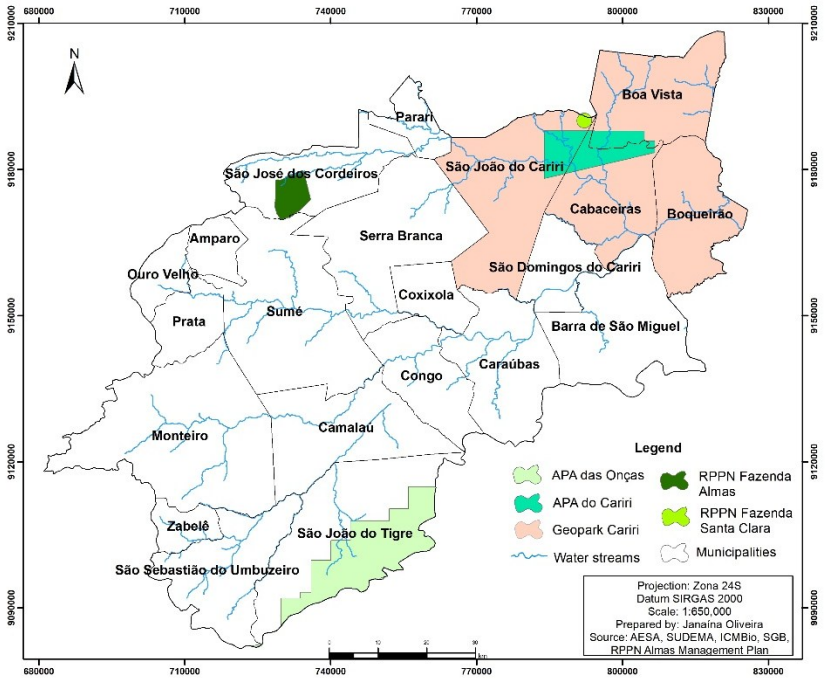


Figure 1 – Study area, with municipalities, main water streams, UCs and the proposal of the Geopark. Source: authors (2026).

To support landscape modeling, an initial mapping of land use and coverage was carried out based on an analysis of images using geographic objects (Geographic Object-Based Image Analysis – GEOBIA). The images were generated by the MultiSpectral Instrument (MSI) sensor of Sentinel-2 on 12/11/2017, year considered neutral considering the rainfall temporal behavior (AESA, 2019) and the phenomena El Niño and La Niña (CPC, 2019). Eight spectral indexes for vegetation and water were applied in ArcGIS. With Definiens e-Cognition, the segmentation of the images was carried out with the multi-resolution algorithm, similarity pattern 100, form 0.1 and compactness 0.5, considering the averages and standard deviations with weights equivalent to 1 (OLIVEIRA et al., 2024).

Seven thematic classes were defined from field visits, namely: Hydrous Body (water accumulated on the surface), Rock Outcrop (rock exposed on the surface), Anthropic Environment (urban/semi-urban occupation and soil exposed mainly due to mining activities); Exotic Forest (predominance of *Prosopis juliflora* [Sw.] DC), Anthropized Area (agropastoral activities with predominant herbaceous vegetation), Rarefied Caatinga (herbaceous, shrubby and/or open arboreal vegetation, partially covering the soil), and Dense Caatinga (denser arboreal-shrubby that fully cover the soil surface). The reliability of the map was verified through ground truth and statistically validated by the Kappa index and a confusion matrix.

Landscape metrics were applied to the generated maps, with particular emphasis on the General Connectivity Index (IIC), modeling based on the Graph Theory carried out by the extension Conefor Sensinode 2.6 in ArcGIS. Such tool offers algorithms that highlight the key patches as per size, shape, spatial location and number of connections established in a predetermined distance (PAESE et al., 2012; SAURA; RUBIO, 2010; ZIOLKOWSKA et al., 2014). Here, the structural connectivity was assessed in two instances: one of up to 1.5km, liable to functionally connect Caatinga patches (ANTONGIOVANNI; VENTICINQUE; FONSECA, 2018); and another of up to 7,5km, so as not to underestimate the structural connectivity on a regional scale.

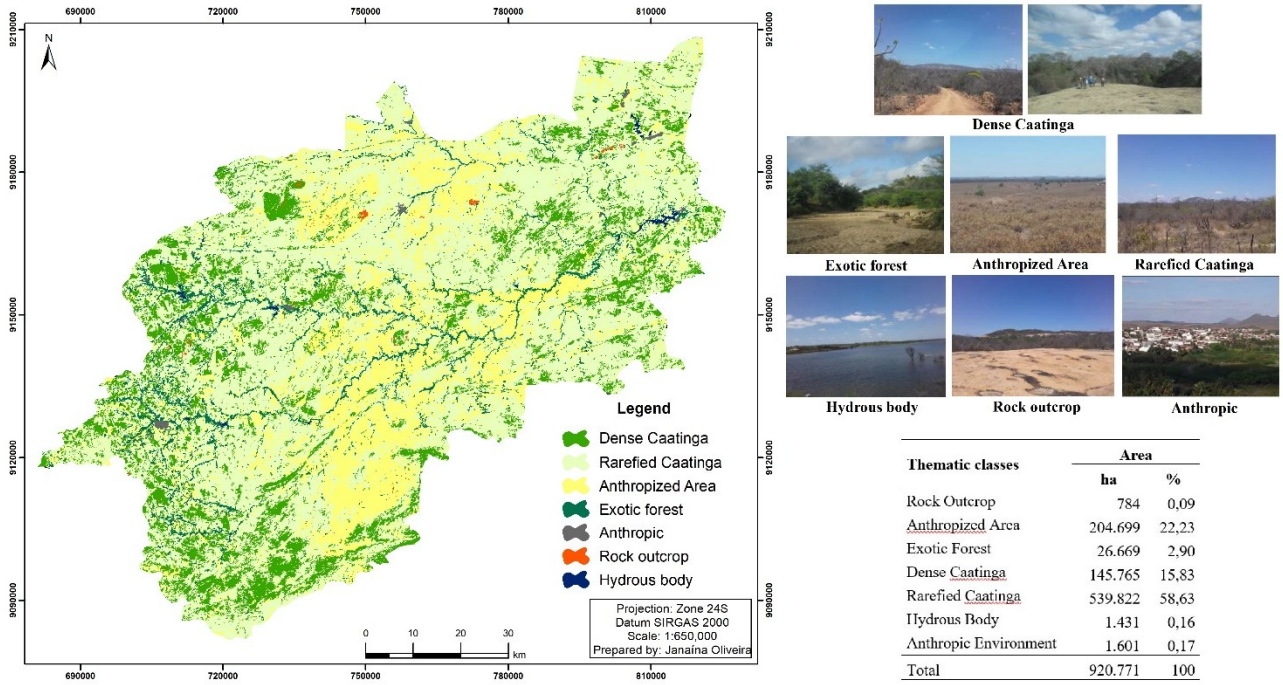
The analysis of the landscape also involved geo-environmental components, with data from the Legal Reserves and UCs; images from the Shuttle Radar Topography Mission (SRTM) for the creation of the Digital Elevation Model (MDE), slope map and application of the Topographic Wetness Index (TWI); in addition to pedology and geomorphology maps by IBGE (scale 1:250,000) and geological maps from the Brazilian Geological Service. The geological interpretation was required for the adaptation of incomplete polygons during the vectorization and construction of the mosaic on scale 1:100,000.

In order to identify the influences and effects of the abiotic factors in the maintenance of the Caatinga considering the landscape dynamism and specific features, this study analyzed and connected the geo-environmental components with the key patches highlighted by the IIC, in which the UCs were also considered as priority areas for structural connectivity; and the Legal Reserves were highlighted according to a spatial positioning considered strategic. It is an integrative approach of physical geography and the Landscape Ecology, which associates the land use and land cover dynamics, the abiotic attributes and the landscape metrics.

It should be noted that the landscape analysis was carried out based on the spatial resolution of the satellite images to interpret the spatial standards on a regional scale. However, the pedological and geomorphological information by IBGE were available only on scale 1:250,000, which justifies the use of these bases only as a support to the regional contextualization and integrated interpretation with the geological data.

3. Results and discussion

The GEOBIA classification had global accuracy of 87% and Kappa coefficient of 0.85, resulting in an excellent-quality map of land use and land cover. The results were obtained with the use of 10 descriptors: standard deviation of band B7, average of bands B2, B3, B5, B6, B8, B12, and spectral indexes MNDWI, NDWI and SAVI. Figure 2 shows the generated map, reference pictures and the quantified areas of each thematic class.



Thematic classes	Area	
	ha	%
Rock Outcrop	784	0,09
Anthropized Area	204.699	22,23
Exotic Forest	26.669	2,90
Dense Caatinga	145.765	15,83
Rarefied Caatinga	539.822	58,63
Hydrous Body	1.431	0,16
Anthropic Environment	1.601	0,17
Total	920.771	100

Figure 2 – Map of land use and land cover with reference pictures and areas quantified of each thematic class. Source: authors (2026).

As can be seen in Figure 2, Rarefied Caatinga is the dominant landscape unit, with 58.63% of the study area. Other landscape metrics emphasized the significant existence of big connected patches, covering 69.71% of the entire class area. Thus, the connectivity model resulted from the application of IIC only for the patches of Dense Caatinga, technically justified by the uniformity of Rarefied Caatinga.

Structural connectivity was measured on a permeable matrix, in which the highest IIC indexes correspond to the most relevant key patches of Dense Caatinga for a connection with the thematic class. Figure 3 shows that the key patches highlighted by IIC are concentrated in the southern part of the Paraíba's Cariri region. When the distance is greater, patches to the northwest and east of the study area also became more relevant.

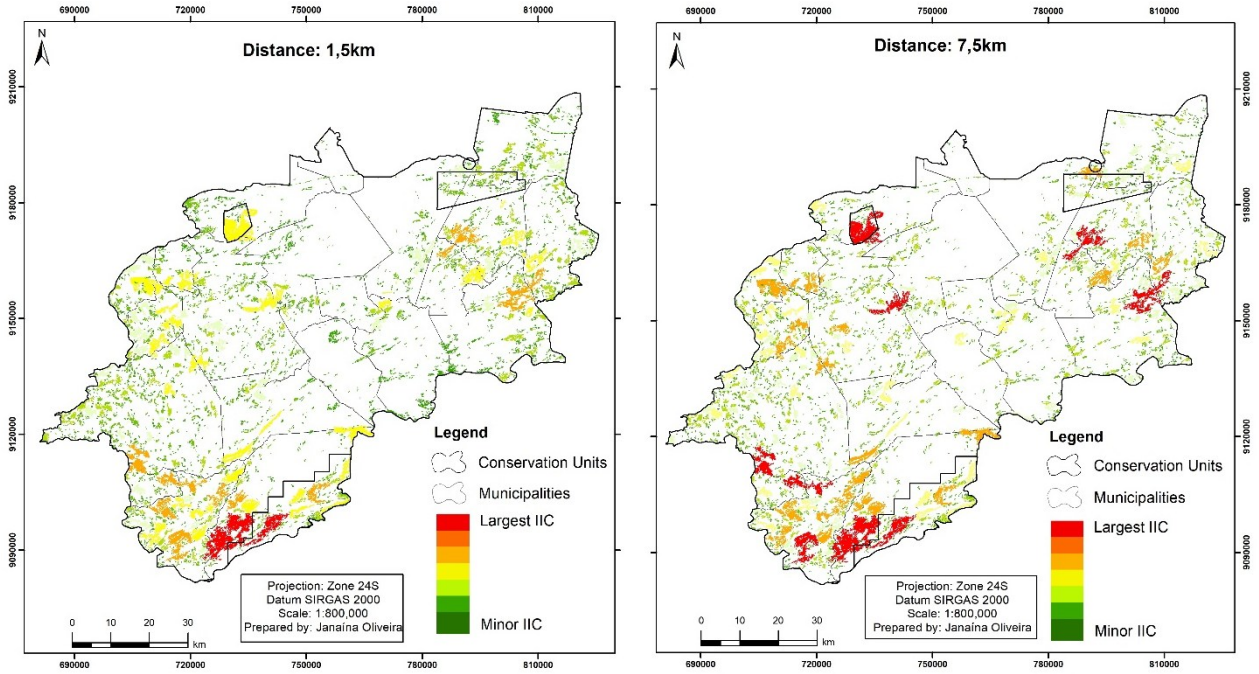


Figure 3 – Modeling from IIC for distances of 1.5km and 7.5km.
Source: authors (2026).

However, the modeling did not show a favorable connectivity scenario for both adopted distances, since there are no patches with higher IIC values that penetrate the matrix. This indicates that small patches, albeit abundant, can be considered not very effective in the role of stepping stones, where spots of habitat dispersed in the landscape enable connectivity within the heterogenous matrix.

The results reveal a possible obstacle to the formation of ecological corridors, with a consequent compromise of the environmental function of these habitats. The highly complex structure of the patches and the high exposure to several anthropogenic threats are pointed out by Antongiovanni, Venticinque and Fonseca (2018) as weak points for the conservation of the Caatinga. However, for the authors, large patches show potential to shelter populations of sensitive species, with lowered capabilities of displacement throughout the matrix, resulting in a reasonable structural integrity of the biome.

In the conception of landscapes that support biodiversity, the quality of the habitat matrix must be based on a structural connectivity that integrates nature conservation areas, their surroundings, and the conservation of large-scale focal habitats (POMIANOSWKI; SOLON, 2020; WARD et al., 2020). However, the results show the vulnerability of the patches of the Dense Caatinga and of the UCs in a clear process of isolation in the study area. It should be noted that two UCs are highlighted in this modeling, in which the patches with high levels of IIC are inserted: Environmental Protection Area (APA) das Onças and RPPN Fazenda das Almas (Privately Owned Nature Reserve).

The APA das Onças, despite being the UC furthest from other protected areas, demonstrated being well connected to the immediate interior and surroundings. Located in the municipality of São João do Tigre, the biggest UC of Paraíba's Cariri was created in 2002, with around 36,000ha, including one of the most important key patches in the modeling with 1.5km distance. The recognition of such territory was strengthened with the Management Plan, a management tool concluded in 2025, with the definition of management zones and programs to promote local development with the conservation of species threatened with extinction.

In the recent Management Plan, the official polygonal had its limits modified and no longer contemplates one of the patches with the highest IIC of the municipality. Before, the UC covered approximately 7,900ha (22% of the APA) of those patches, and was reduced to 2,050ha (5% of the UC). In spite of the loss of legal protection, the IIC result indicates a possible functional connectivity in the surroundings to support the displacement of native species and the existing gene flow.

When the connectivity distance rises to up to 7.5km, it can be seen that the RPPN Fazenda das Almas protects one of the highest IIC key patches. Located between the municipalities of São José dos Cordeiros and Sumé, the UC covers 5,503ha, of which 2,815ha (51%) correspond to the part with the highest IIC. Such results demonstrate the opportunity to meet the main objective of the RPPN: protecting the natural resources in the region.

According to the Management Plan, 35% of the territory refers to the wilderness area, represented by the highest degree of conservation of the biodiversity and integrity of the natural resources, with significant areas of rock outcrop associated with the peculiar vegetation. Such zone was fully contemplated by the key patch highlighted in the IIC. However, the RPPN is critically isolated not only from the other UCs of the Paraíba's Cariri region, but also from the other Dense Caatinga patches around it.

Another care scenario is observed in the APA do Cariri and in the RPPN Santa Clara. Although they are close to each other, they did not show high IIC patches in the two adopted distances. This region is under significant pressure from human activities, particularly bentonite mining, but it also stands out for the interest in the conservation of the geological and geomorphological heritage in an international level, with the proposal of the Cariri Geopark. Even though they are located in potential geological and geomorphological sites, many of the mining activities do not have effective environmental management plans, which can generate socio-environmental conflicts between the rural use and the purposes of the UCs.

The complete isolation of native remnants is a consequence of the fragmentation effects. During this process, there is a latency period between the habitat modification and the structural stability of the landscape, which can cause an ecological debit with ulterior elimination of sensitive species, causing losses in the functionality of the ecosystem and compromising the main role of the UCs (HERRMANN, 2011; HADDAD et al., 2015; PAESE et al., 2012).

In this sense, Meiado et al. (2020) point out the importance of integrating the several sectors of the society to reduce environmental degradation. For the authors, public policies and public-private associations are considered essential to reorganize the use of the territory and should stimulate sustainable productive practices that generate income and, at the same time, involve the community in environmental recovery practices.

When dealing with habitat connectivity, the graphs provide a spatially explicit representation, in which the models can be adapted to represent the complexity of the area under analysis. Therefore, the individual landscape elements guide the efforts for conservation, being essential to identify the main corridors between the patches highlighted by the IIC (SAURA; RUBIO, 2010; ZIOLKOWSKA et al., 2014).

From the perspective of the pedological aspects, the key patches follow a distribution pattern associated with the Lithic Orthent, most part of which is found in undulating to rugged terrain, as is the case of the RPPN Fazenda das Almas and the APA das Onças. According to Santos (2017), these soils are poorly developed, shallow, stony, with frequent rock outcrops. In the Brazilian semi-arid, they mostly occur in dynamic reliefs. Because they do not possess features suitable for intensive farming, they are recommended for the preservation of flora and fauna.

In spite of the different scales of the maps, the correlation between Lithic Orthent and granitic rocks was observed, particularly in intrusive suites that emerge on the surface. This relationship indicates the need for detailed studies on the distribution, characterization and classification of the soils in higher categorical levels to support conservation actions for the Caatinga. The correlation between the rock outcrops and key patches is also identified when analyzing the geology of the region, where the UCs have lithostratigraphic units in common (Figure 4).

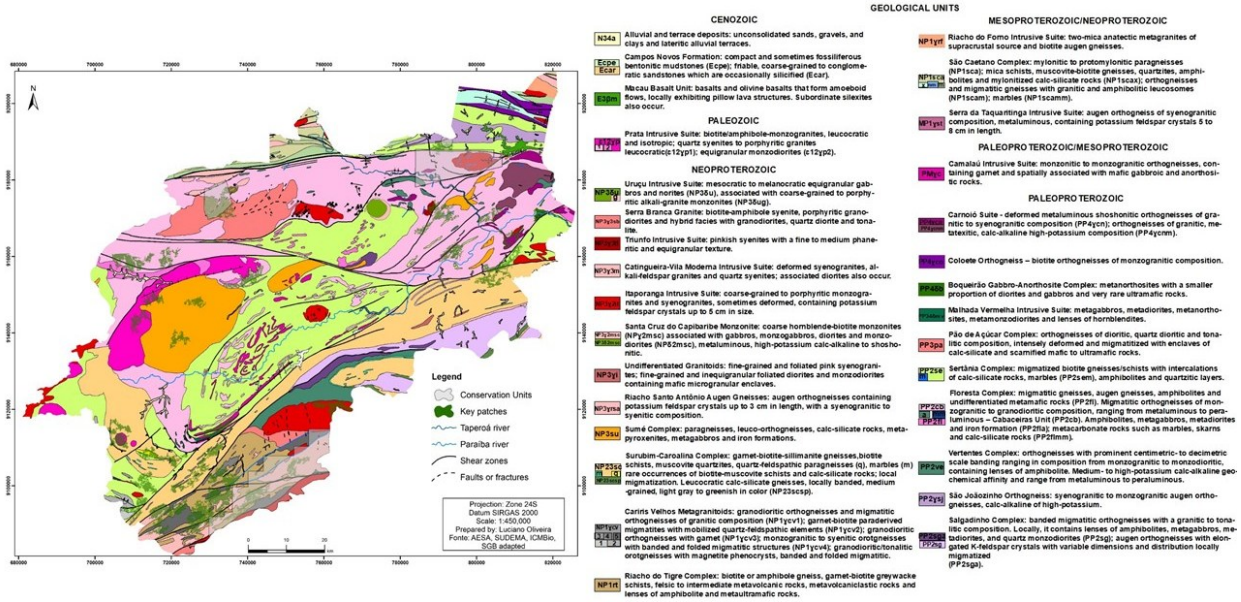


Figure 4 – Geological map of the study area superimposed on the key patches, UCs and main intermittent rivers. Source: authors (2026).

It can be noticed that the APA das Onças and the APA do Cariri share the occurrence of intrusive bodies, represented by the Itaporanga Intrusive Suite. The same unit is identified in the Engabelada Mountains, rock outcrop in the municipality of Congo with a more rounded shape, sheltering small remnants of Dense Caatinga that were not highlighted by the IIC. In the RPPN Fazenda das Almas, the patches with higher IIC are also associated to the massif of Serra Branca Granite. In all cases, Lithic Orthent is present.

It is also possible to observe that the key patches are less present in areas with metasedimentary rocks. In the Sertânia Complex, for example, some spots of Dense Caatinga – highlighted or not by IIC – are clearly associated to the granitoids that stand out in the landscape, with elongated or rounded features, formed by the Camalaú Intrusive Suite and crests formed by the Cabaceiras Orthogneiss of Floresta Complex, which follow the shear zones, faults and/or fractures.

In the geomorphological compartmentalization of the upper Paraíba River basin presented by Rodrigues and Lima (2020), these areas correspond to Remobilized Massifs of the Transverse Zone Domain with symmetric crests and inselbergs, characterized by the presence of Lithic Orthent covered by shrubby and dense sub-shrubby caatinga, with intensive livestock farming. This scenario emphasizes the importance of establishing good agricultural practices, including subsistence farming; and, whenever possible, restricting the access of animals to the preserved environments.

In the study region, the slope map and the MDE showed that the areas with higher elevations and steeper slopes correspond to lower values of TWI, i.e., they are areas with lower accumulation of moisture and sediments – which is compatible with the lithostratigraphic units composed by crystalline rocks. The TWI values transition in the hillsides, where the accumulation of sediments start, in a clear relation with geological faults and/or fractures (Figure 5), up to the highest values in areas corresponding to floods from ephemeral or intermittent rivers.

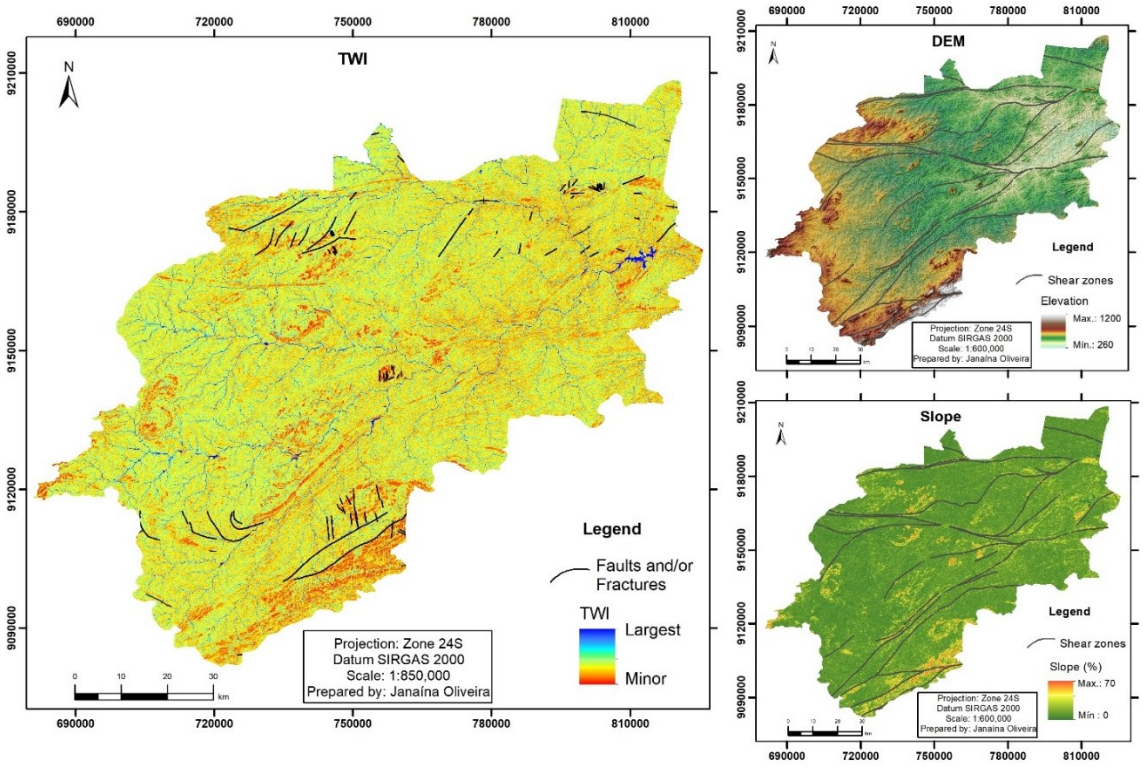


Figure 5 - Topographic Wetness Index, Digital Elevation Model and slope map of the study area. Source: authors (2026).

Figures 4 and 5 clearly show the parallelism between the topographic contour lines and the shear zones, which cover great extensions associated to granitic rocks. Such areas are more resistant in the landscape, where soil, lithological and topographic conditions favor the maintenance of Dense Caatinga patches and naturally restrict anthropogenic actions, concentrated in the lower regions on sedimentary rocks, with higher accumulation of sediments and moisture.

The results highlight that the geo-environmental components analyzed are beneficial to the preservation of the Dense Caatinga patches. According to Vasconcelos and Souza (2018), topographic influence and orographic control determine the moisture distribution over the landscape, where areas with higher elevation are responsible for the surface runoff and correspond to the sediment production zones, in spite of the presence of sub-humid enclaves due to variations in elevation and precipitation volume. Slopes, in turn, have surface runoff until the sediment deposition and moisture reach the peak along the riverbanks.

Complementarily, the shapes of the residual relief associated to saprolitization and weathering, particularly the dissolution basins and grooves – as presented by Maia and Nascimento (2018) –, are herein considered fractal representations of the geological structures identified on a regional scale. Thus, from a landscape perspective, it can be considered that the topographic contour lines and the shear zones are regions with potential for the formation of ecological corridors in the Caatinga.

According to Pereira and Cestaro (2016), the pioneering projects for ecological corridors in Brazil adopted criteria that were primarily functional in order to establish connection networks between the existing UCs. However, they directed the selection to potential conservation areas, without indicating the best possibilities to connect the native remnants – where opportunities and conflicts arise between conservation and economic interests.

On a regional scale, the ecological corridors are considered strategic units for land-use planning and management that must integrate areas used by the human population, promote sustainable development and ensure the conservation of nature (HERRMANN, 2011). The participation of the local actors is essential to minimize the possible conflicts of interest in land use.

In this regard, the Legal Reserves play an important role in the formation of corridors as they refer to rural areas intended for the rehabilitation of ecological processes and the ensure sustainable use of the natural resources. In the Caatinga, they represent 20% of the rural land and are intended for the conservation of the biodiversity, the sustainable use of the natural resources or the rehabilitation of ecological processes. But the regularization of those reserves is still a challenge in environmental management, especially in the validation of the properties registered by the environmental bodies and the regularization of liabilities.

Riparian forests can also contribute to the ecological connectivity between remnants of native vegetation; however, they were disregarded in the present study due to the distribution pattern of the Exotic Forest class. Although accounting for only 2.9% of the study area, the invasive species is found near dams and along the banks of intermittent and ephemeral watercourses, which impairs the feasibility in the formation of corridors linked to those environments, in addition to drawing the attention to the absence of legal instruments for protection and management of the Caatinga riparian forests.

Hence, the proposal for connectivity herein was based on large geological structures that permeate the matrix to integrate the UCs and the patches highlighted by IIC. The use of shear zones is justified by their well-defined linearity, in addition to the identification of the parallelism between the topographic features.

Due to the heterogeneity of the matrix and the isolation of Dense Caatinga patches, a buffer of 1.5km was considered to enable functional connectivity between the fragments and legal reserves next to or superimposed on the topographic features, shear zones and areas with lower TWI values in the proposal of the structural corridors of the landscape on a regional scale (Figure 6).

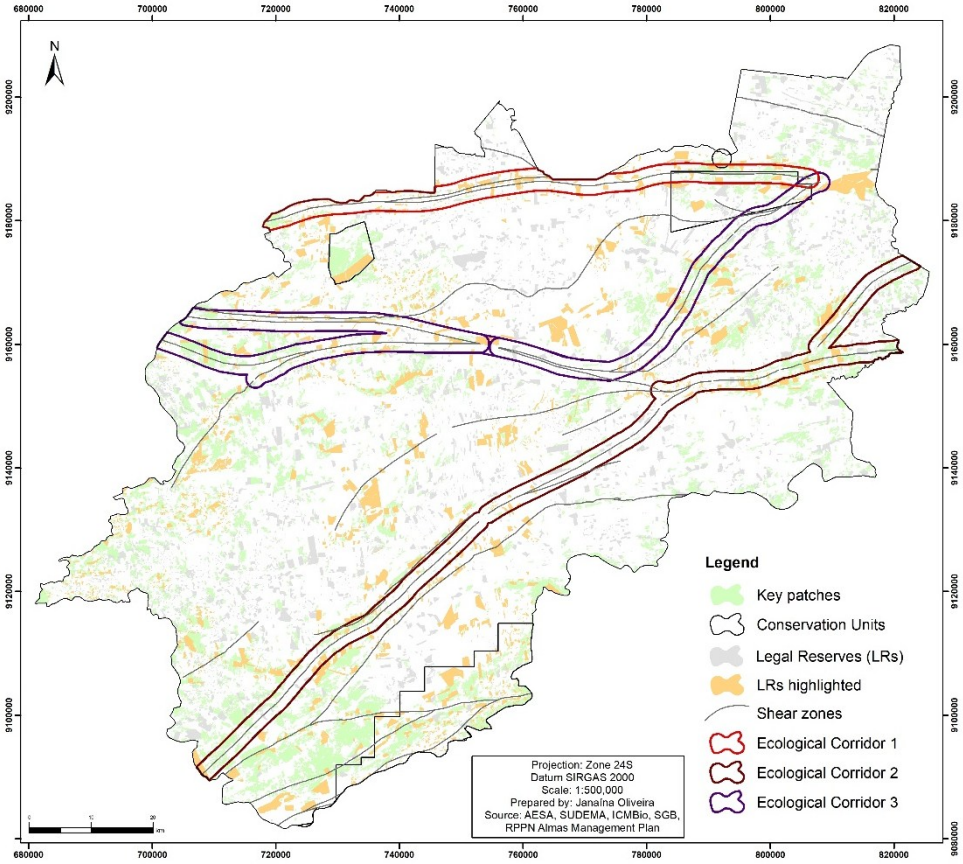


Figure 6 - Legal Reserves and ecological corridors highlighted for structural connectivity in the Paraíba's Cariri. Source: authors (2026).

In addition to technical and scientific knowledge, the delimitation of the corridors must involve participatory processes before drafting regulatory acts. Meiado et al (2020) consider that the unique features in the interaction between society and environment can directly influence the conservation of the Caatinga. In this case, the participation can help ensure the effective creation of the corridors as effective measures to avoid the advance of the areas susceptible to desertification, expand good agricultural practices, and boost efforts in the recovery of the Legal Reserves and in the creation of new UCs.

4. Final considerations

Under the perspective of Landscape Ecology, the results show that the Rarefied Caatinga is predominant in the study area. The Exotic Forest, although unrepresentative in terms of area, presents a distribution pattern that hinder the creation of ecological corridors through the riparian forests, as Huarango trees tend to cover riverbanks and drainage systems. Thus, the connectivity modeling resulted from the IIC applied to the Dense Caatinga, with no identification of key patches that extended across the matrix.

The isolation of that class was highlighted in the two scenarios. For the distance of up to 1.5km, the IIC key patches are concentrated in the southern part of the Paraíba Cariri region. When amplified to up to 7.5km, patches to the northwest and east of the study area become relevant to the structural connectivity.

The analysis also incorporated the geo-environmental components of the region, and it is possible to conclude that the parallelism between the topographic contour lines and the shear zones are elements facilitating the formation of the ecological corridors in the region of the Paraíba's Cariri. The proposal for structural connectivity herein was based on the

fractal theory, where the geomorphological features of residual landforms are repeated on a regional scale, represented by the geological structures.

As a planning instrument capable of avoiding the isolation of UCs and promoting connectivity between patches of native vegetation remnants, these guidelines for the formation of the ecological corridors should be considered a basis for more detailed research in the nature sciences, incorporating biological, geo-morphological, and pedological surveys alongside sociocultural and economic aspects.

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