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PARQUE ESTADUAL DE PARAÚNA: PHYSICAL CHARACTERIZATION AND ASPECTS OF GEODIVERSITY

PARQUE ESTADUAL DE PARAÚNA: CARACTERIZAÇÃO FÍSICA E ASPECTOS DA GEODIVERSIDADE

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Abstract

Geodiversity constitutes a fundamental component of the Earth system, expressing the diversity of abiotic elements and processes that structure and condition the landscape. This study aimed to identify and analyze the main elements of geodiversity present in Parque Estadual de Paraúna (PEPa), located in the municipality of Paraúna in southeastern Goiás State. The analysis is based on the concept of geodiversity as an integrating component of the Earth system, as proposed by Gray (2004), encompassing rocks, landforms, soils, hydrography, and the processes responsible for their genesis and evolution. The physical-natural characterization of PEPa was carried out through the compilation and integrated analysis of thematic maps of geology, geomorphology, hypsometry, hydrography, and soils, combined with a literature review and the interpretation of geomorphological processes associated with the geological formations of the area. The park contains records of the Aquidauana Formation, with isolated outcrops of the Adamantina Formation at the top of Serra da Portaria. From a geomorphological point of view, plateau-type relief forms predominate, with a secondary occurrence of terraces in the northeastern portion of the area. Parque Estadual de Paraúna is located on the hydrographic divide of the Tocantins and Paraná river basins, with most of its area within the Verde (or Verdão) river basin and a small portion belonging to the Cervo stream basin. Red-Yellow Latosols predominate, developed on more stable geomorphological surfaces. The results highlight the importance of geodiversity as a structuring basis of the landscape and provide support to environmental conservation, territorial planning, and geotourism in PEPa.

Keywords: Geodiversity; Parque Estadual de Paraúna; Serra das Galés; Serra da Portaria.

Resumo

A Geodiversidade constitui um componente fundamental do sistema terrestre, expressando a diversidade dos elementos abióticos e dos processos que estruturam e condicionam a paisagem. O presente estudo tem como objetivo identificar e analisar os principais elementos da Geodiversidade presentes no Parque Estadual de Paraúna (PEPa), localizado no município de Paraúna, sudeste do estado de Goiás. A análise fundamenta-se no conceito de Geodiversidade enquanto componente integrador do sistema terrestre, conforme proposto por Gray (2004), compreendendo rochas, formas de relevo, solos, hidrografia e os processos responsáveis por sua gênese e evolução. A caracterização físico-natural do PEPa foi realizada a partir da compilação e análise integrada de mapas temáticos de geologia, geomorfologia, hipsometria, hidrografia e solos, articulados à revisão bibliográfica e à interpretação dos processos geomorfológicos associados às formações geológicas da área. No parque ocorrem registros da Formação Aquidauana, com afloramentos isolados da Formação Adamantina no topo da Serra da Portaria. Do ponto de vista geomorfológico, predominam formas de relevo do tipo chapadas, com ocorrência secundária de patamares na porção nordeste da área. O PEPa localiza-se sobre o divisor hidrográfico das bacias dos rios Tocantins e Paraná, sendo a maior parte da área inserida na bacia do rio Verde (ou Verdão) e uma pequena porção pertencente à bacia do ribeirão do Cervo. Em relação aos solos, predominam Latossolos Vermelho-Amarelos, desenvolvidos sobre superfícies geomorfológicas mais estáveis. Os resultados evidenciam a importância da geodiversidade como base estruturante da paisagem e como subsídio à conservação ambiental, ao planejamento territorial e ao Geoturismo no Parque Estadual de Paraúna.

Palavras-chave: Geodiversidade; Parque Estadual de Paraúna, Serra das Galés; Serra da Portaria.

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INTRODUCTION

Earth is a dynamic and complex planet with a history of continuous change since its formation approximately 4.6 billion years ago. All parts of the planet and interactions, taken together, constitute the Earth system. The diversity of abiotic natural elements, which are understood as geodiversity, are included in this system. Gray (2004) defined geodiversity as a strong integration structure for Earth Sciences, with the scope of rocks, minerals, fossils, sediments, landforms, soils and their processes, which makes it possible to understand the geosphere as having a range of roles and values that need protection and conservation.

The Brazilian state of Goiás, in the Center-West Region of the country, is rich in geodiversity that must be preserved and conserved. Among the various areas of the state is Parque Estadual de Paraúna (PEPa), located in the southeast in the municipality of Paraúna, Sul Goiano Mesoregion and Vale do Rio dos Bois Microregion (IBGE, 2009). The municipality is approximately 150 kilometers from Goiânia, the state capital (156 km via BR 060, GO 164 and GO 320; 147 km via GO 050 and GO 408), and stands out for its tourist potential and various aspects of its geodiversity.

Despite the relevance of geodiversity for understanding environmental dynamics, for the conservation of geological heritage, and for territorial planning, there remains a scarcity of systematic studies that integrate, in an articulated way, the geological, geomorphological, hypsometric, hydrographic, and pedological elements in conservation units in the state of Goiás. Although the area of PEPa is widely recognized for its unique geomorphological features and tourism potential, there is a lack of an integrated analysis of geodiversity that would allow for an understanding of the physical processes responsible for shaping the landscape and support effective actions for geoconservation, management, and sustainable use. This scientific gap constitutes the main research problem addressed in the present study, which seeks to answer the following question: how does the interaction between rocks, relief, drainage, and soils structure the geodiversity of PEPa?

As created by Decree-Law No. 5,568 of March 18, 2002, PEPa encompasses approximately 3,250 hectares. It was created, according to Goiás (2019), with the aim of preserving two geological monuments of the region: Serra das Galés in the eastern section of the park, and Serra da Portaria, in the western section. These monuments are important components of the history of the local population and constitute a relevant tourist attraction in the region. Located approximately 22 kilometers north of the city of Paraúna, the urban area of the municipality, PEPa is accessed by the unpaved road GO 411. In this context, the present work aimed to identify and analyze, in an integrated way, the elements of the geodiversity of PEPa. Thus, the following two stages were developed: (i) physical-natural characterization of the park based on integrated analysis of geological, geomorphological, hypsometric, hydrographic and pedological data; and (ii) interpretation of the relationships between geological formations and geomorphological processes responsible for the configuration of the landscape. This approach is expected to provide technical and scientific support to the management of the conservation unit, the appreciation of its geological heritage, and the development of geotourism practices.

METHODOLOGY

The study methodology was structured to directly address the proposed objectives, ensuring coherence between the analysis and the purpose of identifying and interpreting the geodiversity elements of PEPa. To this end, a qualitative and integrative approach was adopted (Soares, 2005), organized into complementary stages that allow for physical-natural characterization, analysis of relationships among abiotic components, and interpretation of results in the context of conservation and sustainable use of the territory.

The first stage, aimed at fulfilling the objective of characterizing the geological, geomorphological, hypsometric, hydrographic, and pedological aspects of the park, involved a systematic bibliographic survey and review of scientific publications, institutional technical documents, and official databases related to the study area and adjacent regions. The analysis of sources was based on the hermeneutic method, understood as an interpretative procedure that allows for a critical understanding of content from its scientific and spatial contexts (Alberti, 1996).

The second stage, associated with the objective of analyzing the relationships between geological formations and geomorphological processes responsible for shaping the landscape, involved compiling, organizing and analyzing, in an integrated manner, thematic maps of geology, geomorphology, hypsometry, hydrography, and soils. The cartographic data were obtained from the Sistema Estadual de Geoinformação de Goiás (SIEG, 2017), the Instituto Brasileiro de Geografia e Estatística (IBGE, 2017), and the Instituto Nacional de Pesquisas Espaciais (INPE, 2020), selected based on institutional reliability, compatible scale, and currentness.

All maps were created using UTM projection, zone 22S, SIRGAS 2000 datum, ensuring spatial standardization and integration of different layers of information. Cartographic analysis allowed spatial patterns, geomorphological compartments, areas of greater altimetric variation, and relationships between lithology, relief, drainage, and soils to be identified, fulfilling the objective of interpreting geodiversity in an integrated way.

To broaden the spatial understanding of geodiversity elements and their relationships with the immediate surroundings of the conservation unit, a three-kilometer buffer zone was adopted from the boundaries of PEPa, as established by CONAMA Resolution No. 428, of December 17, 2010. The use of this buffer allows the analysis of physical processes that extend beyond the administrative boundaries of the park, such as the continuity of landforms, drainage organization, and soil distribution, and enables the identification of potential anthropogenic pressures that may influence the integrity of geodiversity elements.

RESULTS AND DISCUSSION

The results obtained from the integrated analysis of geological, geomorphological, hypsometric, hydrographic, and pedological data allow for a detailed understanding of the physical-natural organization of PEPa and the dynamics of the processes that shape its landscape. In this sense, the results were organized into four thematic axes—geology, geomorphology, hydrography, and soils—highlighting, in each of them, the main spatial

patterns identified, their relationships with the other components of the physical system, and their relevance to understanding geodiversity.

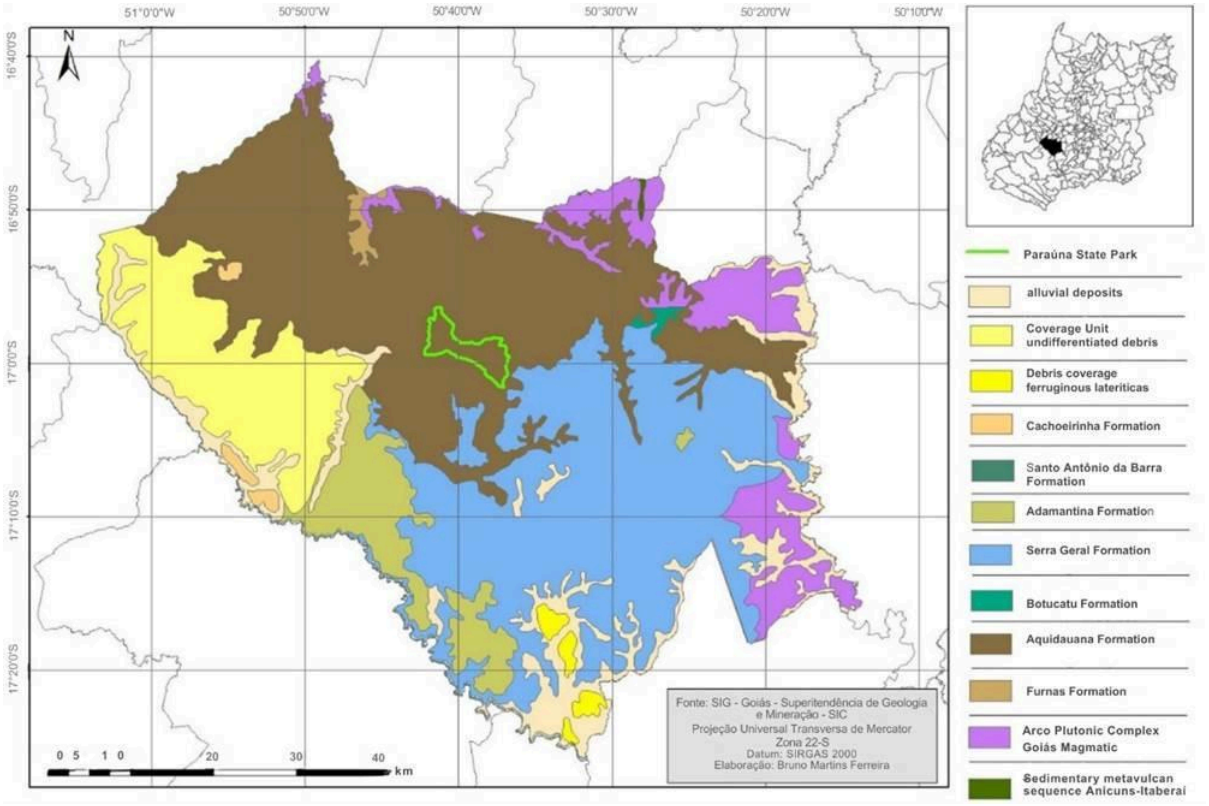
Geology

According to Goiás (2008), the topography of Paraúna was shaped by the lithology of the Paraná Sedimentary Basin, an extensive intracratonic structure formed on the continental crust, occupying an area of approximately 1,400,000 km² in Brazil, Argentina, Uruguay and Paraguay (Milani et al., 1998). This sedimentary basin was formed by the reactivation of Brazilian structures through field compressional forces triggered by the orogeny that occurred in the Ordovician, around 450 Ma (Milani et. al., 1994). The geological records of the basin in Goiás are represented by the following groups: Rio Ivaí, Paraná, Itararé (Aquidauana and Furnas formations), São Bento (Botucatu and Serra Geral formations) and Bauru (Adamantina and Marília formations; *sensu* Fernandes; Coimbra, 1996).

Records of the Aquidauana Formation, with isolated outcrops of rocks from the Adamantina Formation at the top of Serra da Portaria, are present within PEPa (not mappable on the scale presented in Figure 01. The Aquidauana Formation occurs in the southwest region of the state of Goiás, in a strip greater than 300 km long (E-W) and 65 km wide, extending from the Paraúna region to the state of Mato Grosso (GOIÁS, 2008). The base of this lithostratigraphic unit presents conglomerates formed of quartz and sandstone pebbles. These rocks are mainly red-purple in color and comprise medium to coarse sandstones that are friable, sometimes feldspathic, with cross-stratification, silicified levels and coarse to locally conglomeratic white sandstones (diamictites) followed by finely stratified siltstones and mudstones and red to greenish gray shales, common to the presence of rhythms formed by thin levels of clay and fine sandstones and siltstones (GOIÁS, 2008). According to Schneider et al. (1974), the rocks of the Aquidauana Formation indicate deposition that occurred in a fluvial and lake environment, with the collaboration of diamictites that suggest glacial influence. Palynological data attributes the age of the unit to the Upper Carboniferous (Daemon and Quadros, 1969).

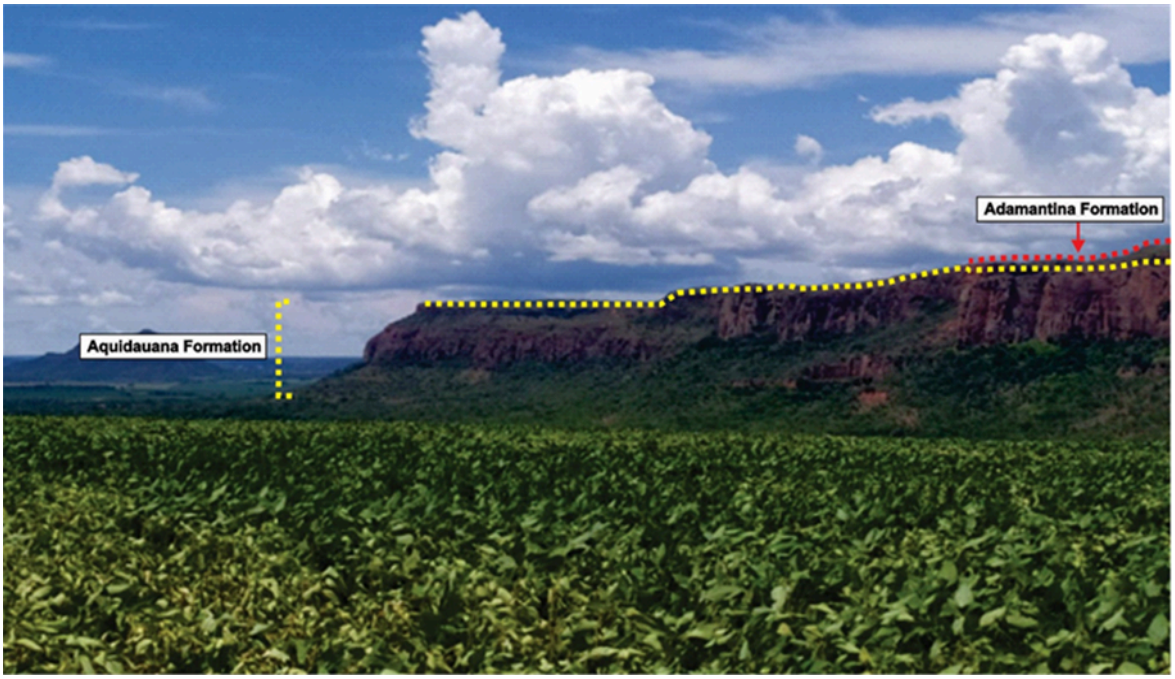
The Adamantina Formation (Bauru Group, Upper Cretaceous) occurs as patches overlying the rocks of the Aquidauana Formation (Upper Carboniferous). According to Fernandes and Coimbra (1996), the Adamantina Formation is formed by light gray, beige or pink solid sandstones with fine to very fine grains (medium grains occasionally occur) that are often poorly sorted and presenting subordinate plane-parallel cross-stratification. For these authors, the lithological and sedimentary characteristics of this formation indicate fluvio-lacustrine sedimentation. The Adamantina Formation was dated from ostracod content as belonging to the Turonian-Santonian (*sensu* Dias-Brito *et al.*, 1996) and emerges irregularly in the south and southwest regions of the state of Goiás. This lithostratigraphic unit occurs in the southeast region of the municipality of Paraúna. Within PEPa, the superposition of the Adamantina Formation on the Aquidauana Formation occurs in the Serra da Portaria mountain range (Figure 02).

Figure 01. Geological map of the municipality of Paraúna.



Source: Ferreira *et al.* (2020).

Figure 02. Paleozoic rocks of the Aquidauana Formation and Upper Cretaceous rocks of the Adamantina Formation.

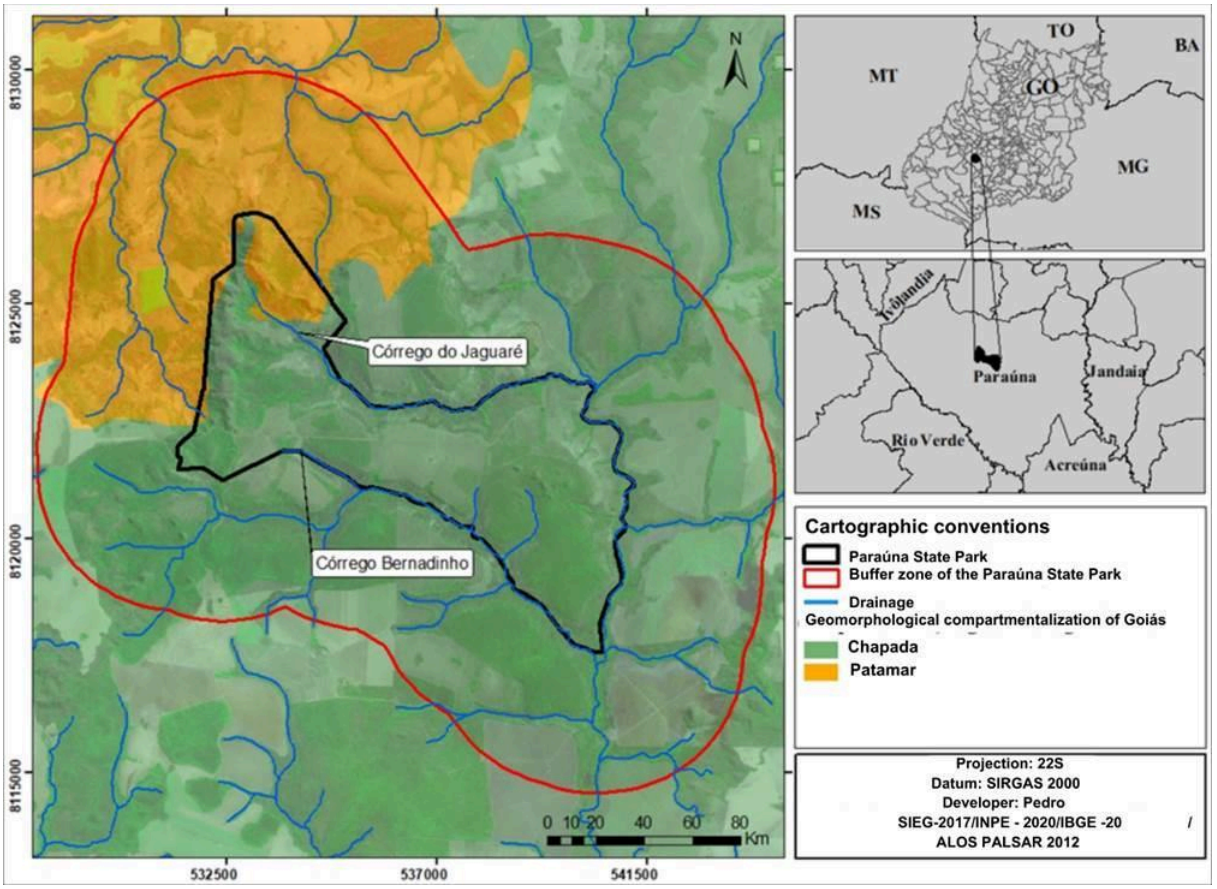


Source: Ferreira 2022.

Geomorphology

According to the geomorphological compartmentalization of the Instituto Brasileiro de Geografia e Estatística, chapadas predominate the topographic surfaces of PEPa, with a small area of patamares in the northeast (Figure 03). The geomorphology technical manual of IBGE (2009) defines chapadas as sets of flat-topped relief forms, created in sedimentary rocks, that are generally limited by escarpments and located at higher altitudes. Patamares are flat or wavy reliefs, created in different classes of rocks, constituting intermediate surfaces or steps between areas of higher relief and topographically lower areas.

Figure 03. Geomorphological map of Parque Estadual de Paraúna.



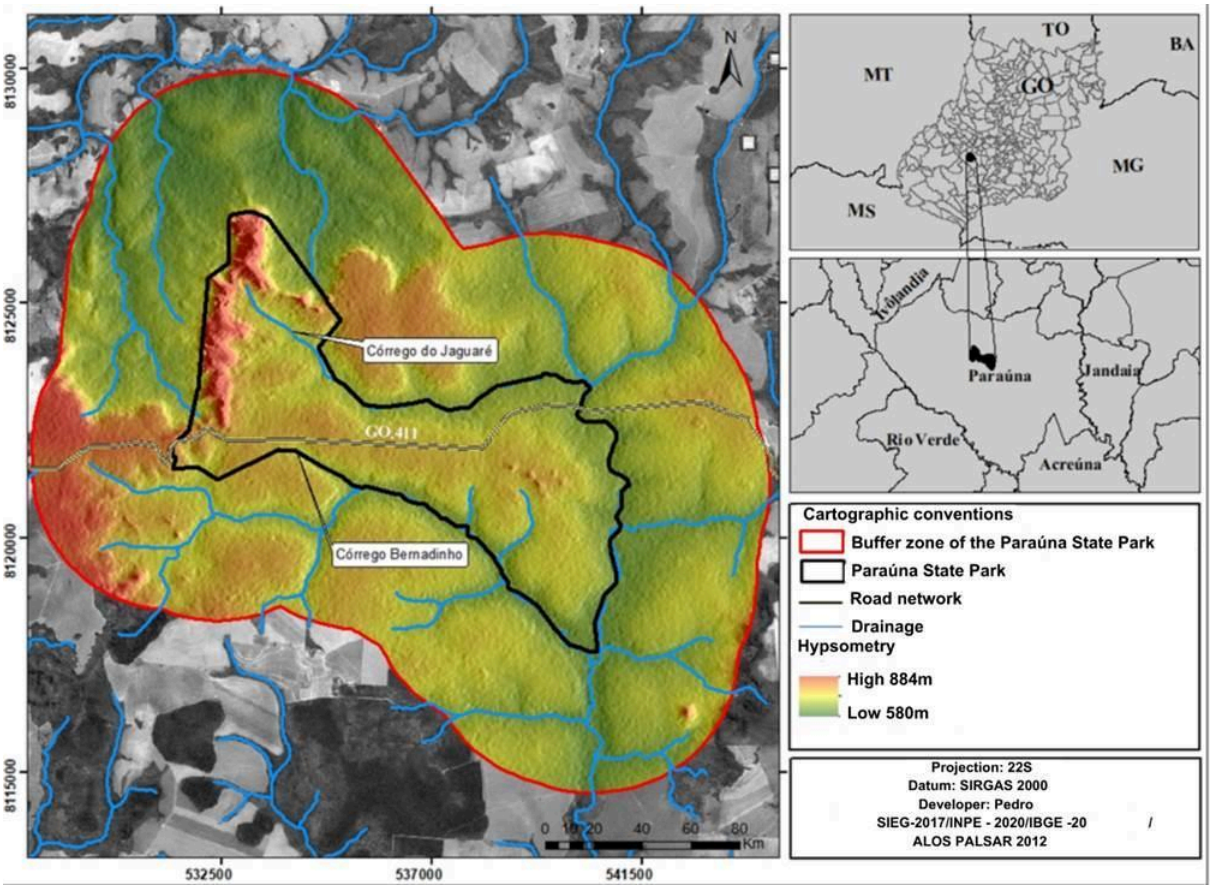
Source: SIEG-2017 / INPE-2020 / IBGE-2017.

Casseti (2005) refers to the north of the Paraná Sedimentary Basin as an example of tabular relief and cites Paraúna as geomorphologically being an area with Carboniferous sedimentary sequences of the Aquidauana Formation that are under Precambrian crystalline structures (gneisses of the Magmatic Arc Complex of Goiás and mica schists of the Araxá Group; Pimentel, 2016) where they are covered by Cretaceous rocks of the São Bento Group (Lower Cretaceous) and Bauru Group (Upper Cretaceous). The geomorphology of the area where the municipality is located today evolved in sedimentary rocks by processes that

formed poorly dissected plateaus and large interfluves that resulted in a very monotonous relief.

Santos (2008) characterized the compartmentalization of the Paraúna landscape and gave a brief description in which the Serra das Galés presents a ruiniform relief related to evolutionary processes of the erosion of furrows in the rock's diaclases. According to this author, events developed that determined the evolution of structures where a rapid transition from a semi-arid to a humid climate occurred. Elevation within PEPa varies from 580 to 884 meters (Figure 04), with the highest part being Serra da Portaria on the park border, to the east of which are several elevations that are geoforms of Serra das Galés.

Figure 04. Hypsometric map of Parque Estadual de Paraúna.



Source: SIEG-2017 / INPE-2020 / IBGE-2017.

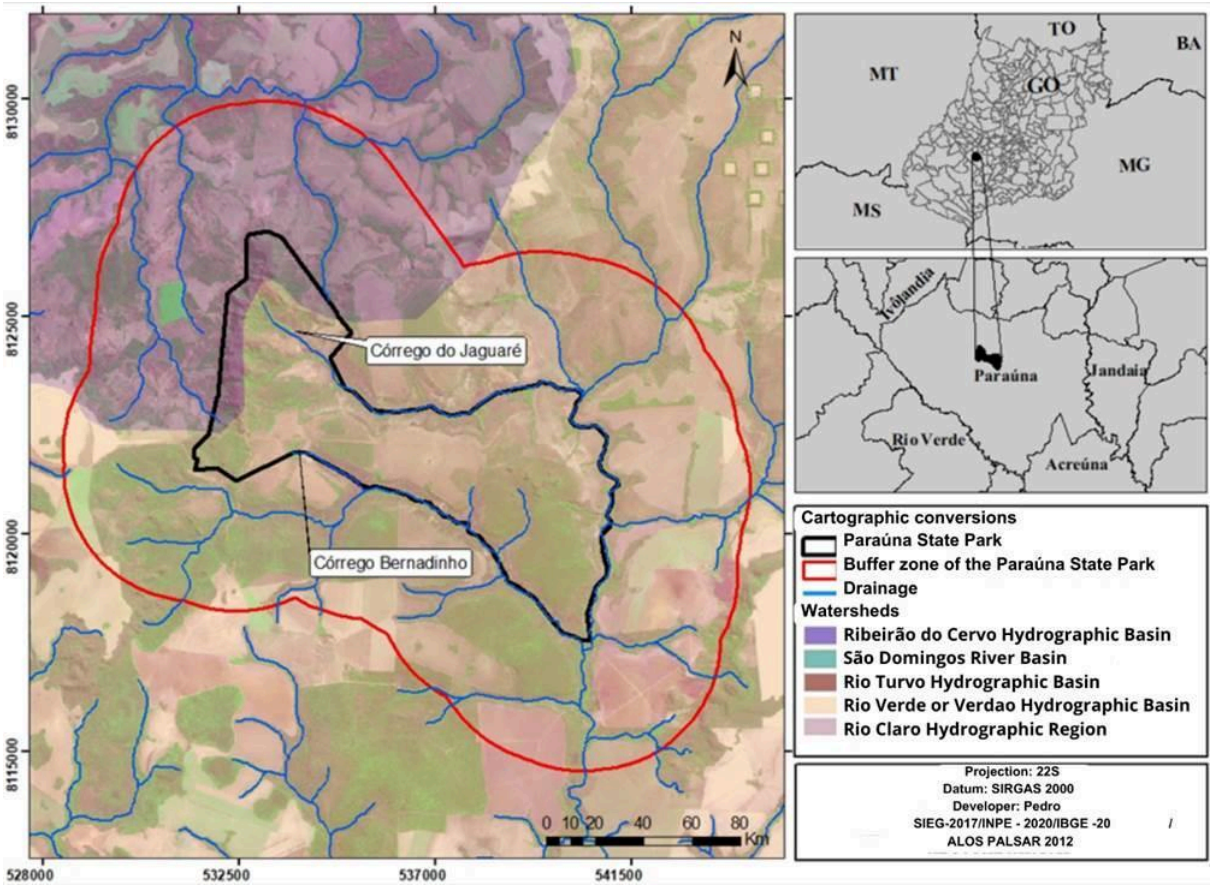
The hypsometric map of PEPa shows that the altimetric distribution directly influences the organization of the hydrographic network, the energy gradient of watercourses, and the dynamics of erosive processes. It also conditions the distribution of soils, favoring the development of thicker Latosols on more stable surfaces and limiting pedogenetic evolution in areas of greater slope. Therefore, hypsometry constitutes a fundamental element for the integrated understanding of the geodiversity of PEPa by integrating lithology, relief, drainage, and soils in the configuration of the landscape.

A comparative analysis with geodiversity inventories developed in other conservation units reveals that the geomorphological processes identified in PEPa are directly conditioned by the geological formations that structure the area, as well as similarities with those observed in conservation units located in similar geological contexts. From this comparative perspective, studies focused on geodiversity inventory and the promotion of geotourism in Parque Nacional da Serra da Canastra (Bento & Rodrigues, 2019) indicate that the association between more resistant sedimentary sequences and tabular landforms favors the identification of geosites with high scenic value and tourism potential. Although the lithological units and geomorphological processes of PEPa present local particularities, the general pattern of interaction between lithology, relief, and drainage, as well as its implications for conservation and geotourism, is largely comparable.

Hydrography

Parque Estadual de Paraúna is on the hydrographic division between the Tocantins and the Paraná rivers. The largest portion of its area is concentrated in the Verde (or Verdão) River Basin, with a small part to the northeast belonging to the Cervo River Basin. Bernardinho and Jaguaré streams (Figure 05) are the main channels that drain the study area.

Figure 05. Hydrographic map of Parque Estadual de Paraúna.



Source: SIEG-2017 / INPE-2020 / IBGE-2017.

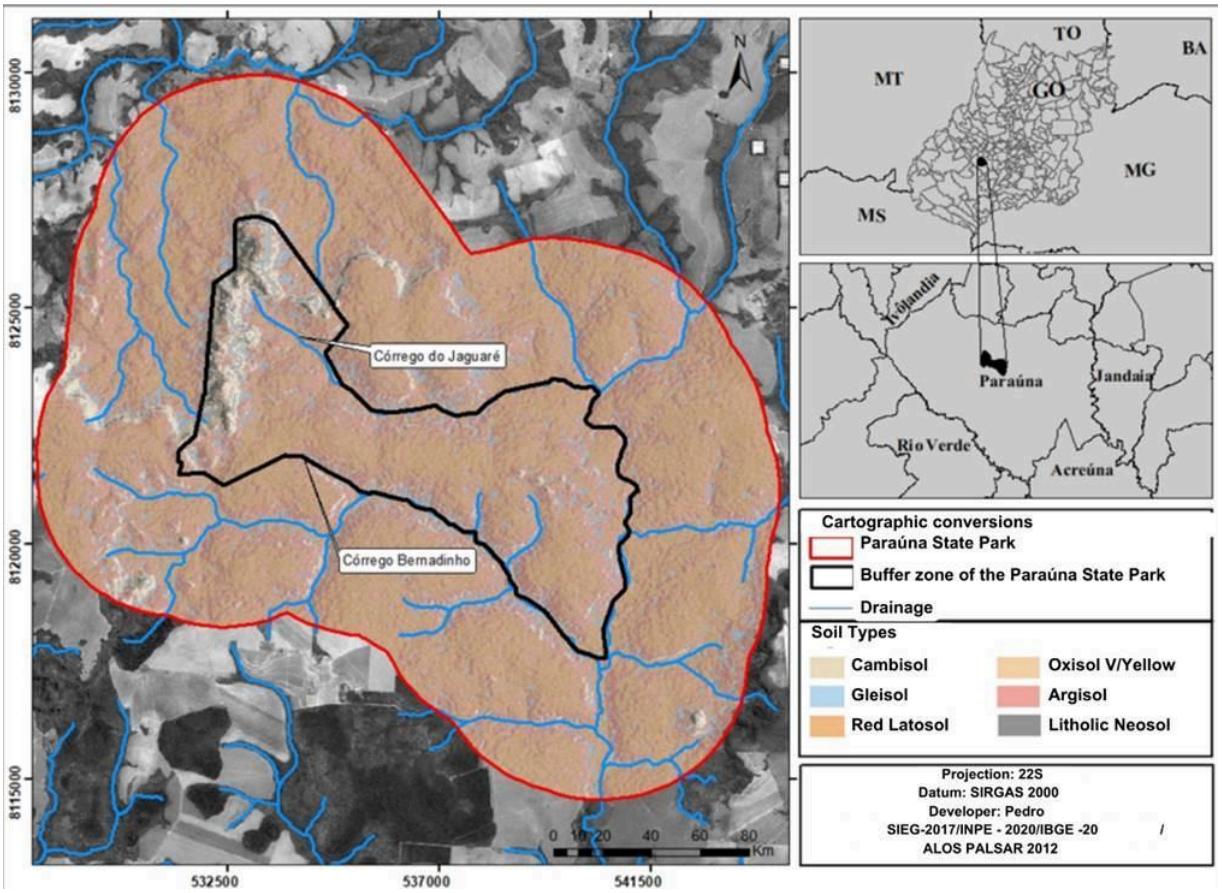
The Verde River, into which the Bernardinho and Jaguaré streams flow, is part of the Paraná River Basin, an important watercourse that flows into the Paranaíba River. The main contributors to the Verde River are the Grande River on the right bank and the Ponte de Pedra stream on the left bank. Cardon (2010), when addressing the Verde River hydrographic basin, mentions that its source presents a certain phenomenon of waters amended under the path, directing its flow 400 meters south of the flooded area through this watercourse towards the Paranaíba Basin and 300 meters north to the Araguaia Basin via the Diamantino River. Its upper reaches contain meandering segments due to the forest and savannah vegetation coverage of the valley.

Soil

Red-Yellow Latosols predominate in PEPa (Figure 06). This soil type has been identified in extensive areas scattered throughout the Brazilian territory in association with plane, smooth-undulating or undulating relief (Embrapa, 1997). These soils are deep and occur in well-drained environments, in addition having uniform depth when analyzed in relation to color, texture and structure. Red-Yellow Latosols are used for agriculture, however, if they are alic, dystrophic or acric, they present chemical limitations in depth to the development of the plant root systems. Phosphorus levels in these soils are low, making phosphate fertilization necessary, while low water availability is also a limiting factor for plants.

The interpretation of the soil map of PEPa shows that the spatial distribution of soils reflects the evolutionary history of the landscape and the balance between geomorphological stability and erosive dynamics. The observed patterns indicate that areas subjected to lower relief energy and milder erosive processes tend to preserve longer pedogenetic records, while sectors marked by greater dissection and drainage control express recurring interruptions in soil development. This relationship suggests that the soils of PEPa function as markers of the intensity of the geomorphological processes at work, integrating information on weathering, material transport, and relief organization.

Figure 06. Soil map of Parque Estadual de Paraúna.



Source: SIEG-2017 / INPE-2020 / IBGE-2017.

FINAL CONSIDERATIONS

The physical-natural characteristics of the municipality of Paraúna include rocks dating from the Neoproterozoic and Cretaceous. However, what draws attention is the occurrence of a part of the Paraná Sedimentary Basin, as its lithology shaped the topography of the municipality. Geomorphologically, the rocks of the Paraná Basin underwent regional flattening processes, the dominant units being the regional flattening surfaces associated with tabular reliefs.

Records of the Aquidauana Formation, with isolated outcrops of rocks from the Adamantina Formation at the top of Serra da Portaria are present within PEPa. Chapadas predominate among the topographic surfaces of PEPa, with a small portion in the northeast having patamares. Elevation within PEPa varies from 580 to 884 meters, with the highest part being Serra da Portaria on the park border, to the east of which are several elevations in Serra das Galés.

Parque Estadual de Paraúna is on the hydrographic division between the Tocantins River and the Paraná River. The largest portion of the area is concentrated in the Verde (or Verdão) River Basin, with a small part to the northeast, belonging to the Cervo River Basin. Bernardinho and Jaguaré streams are the main channels that drain the study area. Red-Yellow Latosols are the predominate soils.

The practical contributions of geodiversity analysis are significant in the environmental management of PEPa, as they provide technical support for territorial planning, defining priority areas for conservation, and monitoring sectors most sensitive to erosion and other environmental impacts. The identification of landforms and features of high scientific, landscape, and educational value reinforces the need for specific geoconservation actions, integrating geological heritage into the management guidelines of the conservation unit.

Furthermore, the results obtained highlight the potential of PEPa for the development of geotourism and geoeducation activities, based on the appreciation of geodiversity and the interpretation of the landscape. Understanding the processes that shape the relief, drainage, and soils can support the development of interpretive trails, educational materials, and public use strategies that reconcile visitation with the conservation of natural elements.

In this way, this study contributes not only to the advancement of scientific knowledge about the geodiversity of PEPa, but also to the practical application of this knowledge in environmental management, geoconservation of geological heritage, and the strengthening of strategies for the sustainable use of the territory. The results presented can serve as a basis for future research and the implementation of integrated geoconservation and geotourism policies within the scope of PEPa.

REFERENCES

ALBERTI, V. A existência na história: revelações e riscos da hermenêutica. *Estudos Históricos*, Rio de Janeiro, v. 9, n. 17, p. 31-57, 1996.

BENTO, L. C. M.; RODRIGUES, S. C. Aspectos geológicos e geomorfológicos da Cachoeira de Casca D'Anta (Parque Nacional da Serra da Canastra – Minas Gerais, Brasil): primeiros passos para o seu aproveitamento geoturístico. *Physis Terrae – Revista Ibero-Afro-Americana de Geografia Física e Ambiente*, v. 1, n. 2, p. 43-60, 2019. DOI: 10.21814/physisterrae.2220.

BRASIL. Lei nº 9.985, de 18 de julho de 2000. Institui o Sistema Nacional de Unidades de Conservação da Natureza (SNUC). *Diário Oficial da União*: seção 1, Brasília, DF, 19 jul. 2000.

CARDON, L. M. *Mapeamento de fragilidade ambiental de bacia hidrográfica com uso de geoprocessamento: Bacia do Rio Verde no sudoeste do estado de Goiás*. 2010. Monografia (Especialização em Geoprocessamento) – Universidade Federal do Paraná, Curitiba, 2010. Disponível em: https://acervodigital.ufpr.br/xmlui/bitstream/handle/1884/34314/LUCIANA%20MACIEL%20CARDON.pdf. Acesso em: 12 jan. 2026.

CASSETI, V. *Geomorfologia*. Livro digital. Goiânia, 2005.

CONSELHO NACIONAL DO MEIO AMBIENTE (CONAMA). Resolução nº 428, de 17 de dezembro de 2010. Dispõe sobre a autorização para o licenciamento ambiental de empreendimentos localizados no entorno de unidades de conservação. *Diário Oficial da União*, Brasília, DF, 20 dez. 2010.

DAEMON, R. F.; QUADROS, L. P. *Bioestratigrafia e palinologia do Paleozóico Superior da Bacia do Paraná*. Ponta Grossa: PETROBRÁS/DESUL, 1969. 69 p. (Relatório Técnico Interno, n. 384).

DIAS-BRITO, D.; MUSACCHIO, E. A.; CASTRO, J. C.; MARANHÃO, M. S. A. S.; FERNANDES, L. A.; COIMBRA, A. M. A Bacia Bauru (Cretáceo Superior, Brasil). *Anais da Academia Brasileira de Ciências*, Rio de Janeiro, v. 68, n. 2, p. 195-205, 1996.

EMBRAPA – EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA. *Sistema brasileiro de classificação de solos*. 2. ed. Rio de Janeiro: Embrapa Solos, 1997.

FERNANDES, L. A.; COIMBRA, A. M. A Bacia Bauru (Cretáceo Superior, Brasil). *Anais da Academia Brasileira de Ciências*, Rio de Janeiro, v. 68, n. 2, p. 195-205, jul. 1996.

FERREIRA, B. M. *Geodiversidade no município de Paraúna/Goiás*. 2016. Dissertação (Mestrado em Geografia) – Universidade Federal de Goiás, Goiânia, 2016.

FERREIRA, B. M.; LIMA, C. V.; CANDEIRO, C. R. A. Geodiversidade geológica e geomorfológica do município de Paraúna, centro-sul do estado de Goiás, Brasil. *Sociedade & Natureza*, Uberlândia, v. 32, p. 586-600, 2020. DOI: 10.14393/SN-v32-2020-47312. Disponível em: https://seer.ufu.br/index.php/sociedadenatureza/article/view/47312. Acesso em: 12 jan. 2026.

FERREIRA, B. M. *Parque Estadual de Paraúna em Goiás/Brasil: valoração dos geossítios e potencial para a geoeducação*. 2022. 73 f. Tese (Doutorado em Geografia) – Universidade Federal de Goiás, Goiânia, 2022.

GOIÁS (Estado). Secretaria de Estado de Meio Ambiente e Desenvolvimento Sustentável. *Parque Estadual de Paraúna*. Disponível em: https://www.meioambiente.go.gov.br/planos-e-projetos/agenda-2030-ods/118-meio-ambiente/unidades-de-conserva%C3%A7%C3%A3o/1105-parque-estadual-de-parauna-pepa.html. Acesso em: 12 jan. 2026.

GOIÁS (Estado). Secretaria de Indústria e Comércio. Superintendência de Geologia e Mineração. *Geologia do Estado de Goiás e do Distrito Federal*. MOREIRA, M. L. O. et al. (Org.). Goiânia: SIC, 2008.

GOIÁS (Estado). *Geomorfologia do Estado de Goiás e do Distrito Federal*. LATRUBESSE, E. M.; CARVALHO, T. M. (Org.). Goiânia, 2006.

GRAY, M. *Geodiversity: valuing and conserving abiotic nature*. Chichester: Wiley & Sons, 2004.

IBGE – INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. *Manual técnico de geomorfologia*. 2. ed. Rio de Janeiro: IBGE, 2009.

IBGE – INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. *Censo demográfico 2010: Pesquisa Nacional por Amostra de Domicílios*. Rio de Janeiro: IBGE, 2011. Disponível em: https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=249230. Acesso em: 12 jan. 2026.

IBGE – INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. *Bases cartográficas e dados geoespaciais do Brasil*. Rio de Janeiro: IBGE, 2017.

INPE – INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS. *Base cartográfica digital e dados altimétricos*. São José dos Campos: INPE, 2020. Disponível em: https://www.inpe.br. Acesso em: 12 jan. 2026.

MILANI, E. J.; FRANÇA, A. B.; SCHNEIDER, R. L. Bacia do Paraná. *Boletim de Geociências da Petrobras*, Rio de Janeiro, v. 8, n. 1, p. 69-82, 1994. Disponível em: https://bgp.petrobras.com.br/bgp/article/view/582. Acesso em: 12 jan. 2026.

MILANI, E. J.; FACCINI, U. F.; SCHERER, C. M. S.; ARAUJO, L. M.; CUPERTINO, J. A. Sequences and stratigraphic hierarchy of the Paraná Basin (Ordovician to Cretaceous), Southern Brazil. *Boletim do IG-USP*, São Paulo, v. 29, p. 125-173, 1998. DOI: 10.11606/issn.2316-8986.v29i0p125-173.

PIMENTEL, M. M. The tectonic evolution of the Neoproterozoic Brasília Belt, central Brazil: a geochronological and isotopic approach. *Brazilian Journal of Geology*, v. 46, supl. 1, p. 1-14, 2016. DOI: 10.1590/2317-4889201620150004.

SANTOS, M. H. M. C. Compartimentação e estruturação da paisagem de Paraúna-GO. *Boletim Goiano de Geografia*, Goiânia, v. 1, n. 1, p. 70-92, 2008. DOI: 10.5216/bgg.v1i1.4271.

SCHNEIDER, R. L.; MÜHLMANN, H.; TOMMASI, E.; MEDEIROS, R. A.; DAEMON, R. F.; NOGUEIRA, A. A. Revisão estratigráfica da Bacia do Paraná. In: CONGRESSO BRASILEIRO DE GEOLOGIA, 28., 1974, Porto Alegre. *Anais*... Porto Alegre: SBG, 1974. v. 1, p. 41-65.

SIEG – SISTEMA ESTADUAL DE GEOINFORMAÇÃO DE GOIÁS. *Base de dados geoespaciais do Estado de Goiás*. Goiânia: SEMAD, 2017. Disponível em: https://www.sieg.go.gov.br. Acesso em: 12 jan. 2026.

SOARES, P. V. *As interrelações de elementos do meio físico natural e modificado na definição de áreas potenciais de infiltração na porção paulista da bacia do rio Paraíba do Sul*. 2005. Tese (Doutorado em Geografia) – Universidade Estadual de Campinas, Campinas, 2005.