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FROM ANCESTRAL LANDSCAPES TO THE TWENTY-FIRST CENTURY: A HISTORICAL AND SOCIO-ENVIRONMENTAL SYNTHESIS OF PARAÍBA, NORTHEASTERN BRAZIL

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Abstract

The history of Paraíba, northeastern Brazil, cannot be adequately understood as a sequence beginning with Portuguese colonization in the sixteenth century. The territory corresponding to the present state was inhabited, managed and culturally transformed by Indigenous peoples long before European arrival, and its subsequent trajectory resulted from continuous interactions among societies, political systems, economic activities, climate, biodiversity and landscapes. This review provides an integrated historical and socio-environmental synthesis of Paraíba from ancestral Indigenous occupation to the twenty-first century. Archaeological heritage, Indigenous territorialities, early European contacts, French-Indigenous commercial networks, Portuguese conquest, sugarcane expansion, slavery, Dutch occupation, cattle ranching, cotton production, drought, political transformations, urbanization and contemporary environmental change are examined as interconnected processes. Particular attention is given to the historical agency and persistence of Potiguara and Tabajara peoples and to transformations of the Atlantic Forest, mangroves, estuaries, Borborema Plateau, Agreste and Caatinga. The analysis indicates that the major economic cycles of Paraíba were simultaneously socio-environmental transitions: brazilwood extraction connected forests to Atlantic commerce; sugarcane reorganized coastal landscapes and labor systems; livestock contributed to occupation of the semiarid interior; cotton intensified market integration; hydraulic infrastructure altered relationships with drought and water; and twentieth-century urbanization changed demographic patterns and resource demands. In the contemporary period, biodiversity loss, land degradation, water insecurity, coastal pressures and climate change interact with historical inequalities and land-use legacies. The 2024 homologation of the Potiguara de Monte-Mor Indigenous Land further illustrates the continuing relevance of territorial rights to cultural and environmental governance. Paraíba constitutes an instructive case for environmental history because its past reveals how political choices mediate human responses to environmental opportunities and constraints, while its future increasingly depends on integrating historical knowledge, Indigenous territorial rights, biodiversity conservation, water security, climate adaptation, renewable energy and socially equitable development.

Keywords: Paraíba. Environmental history. Indigenous peoples. Potiguara. Tabajara. Atlantic Forest. Caatinga. Drought. Climate change. Cultural heritage.

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1 Introduction

Paraíba occupies a relatively small but environmentally heterogeneous territory in northeastern Brazil. From the Atlantic coast westward, the state encompasses estuaries, mangroves and remnants of Atlantic Forest, transitional Agreste landscapes, the Borborema Plateau and extensive semiarid areas dominated by Caatinga (Figure 1).

These gradients of rainfall, relief, vegetation, soils and hydrology have repeatedly influenced settlement, production, mobility and political strategies. They did not, however, determine historical outcomes mechanically: institutions, labor regimes, technology, land tenure, markets and political power mediated how societies used and transformed the environment (AB'SÁBER, 2003; SILVA; LEAL; TABARELLI, 2017; WORSTER, 1990).

Conventional histories frequently begin with Portuguese expansion and the foundation of Nossa Senhora das Neves in 1585. That date is crucial to colonial history but cannot represent the beginning of Paraíba's human history. Archaeological sites and Indigenous cultural landscapes demonstrate a much deeper chronology. The Itacoatiaras do Rio Ingá, protected as national heritage since 1944, and other archaeological occurrences documented by IPHAN provide material evidence that the territory was culturally meaningful long before European occupation (IPHAN, 2022).

This deeper chronology also changes the role assigned to Indigenous peoples. Potiguara, Tabajara and diverse inland populations were not passive obstacles to European colonization. They negotiated alliances, resisted military campaigns, moved through territories, adopted and reshaped political strategies and, in the seventeenth century, participated in transatlantic diplomatic networks.

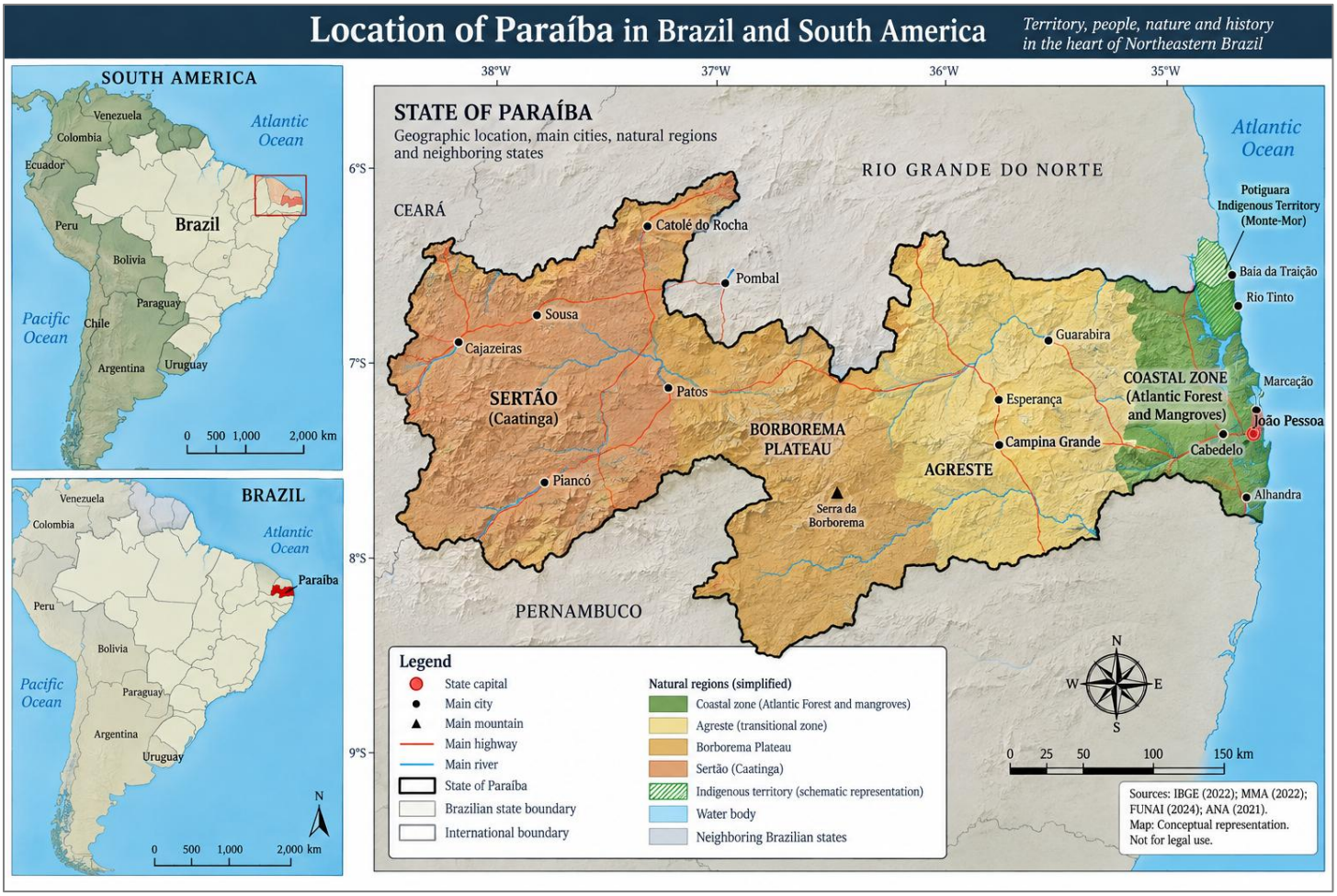

Figure 1. Geographic location of Paraíba in Brazil and South America.

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Recent scholarship on Potiguara petitions and the 1645 Tapesserica Assembly has further demonstrated Indigenous political agency during the Dutch-Portuguese wars (SIMÕES, 2016; SILVA; COSTA; MIRANDA, 2024; MIRANDA, 2025; PAIVA, 2025).

An environmental-history perspective similarly changes the interpretation of colonial and postcolonial economic cycles. Brazilwood extraction transformed forest organisms into Atlantic commodities; sugarcane plantations reorganized coastal land, forests and labor; cattle ranching supported the advance of colonial settlement into the semiarid interior; cotton strengthened commercial connections between inland Paraíba and external markets; reservoirs and hydraulic works reconfigured water governance; and urbanization concentrated population, infrastructure and environmental demand in regional centers (GALLOWAY, 1968; PEREIRA, 2021; MACHADO; DIAS; SILVA, 2017).

This review therefore examines Paraíba as a succession of overlapping socio-environmental transitions rather than as a purely political chronology. Its objectives are to synthesize the state's history from ancestral Indigenous occupation to the present; foreground Indigenous agency and persistence; relate major economic systems to landscape transformation; interpret drought as both climatic hazard and socially mediated vulnerability; connect historical land use with present conservation problems; and discuss how historical experience can inform climate adaptation and sustainable development.

2 Material and Methods

This article is a narrative historical and socio-environmental review. A narrative approach was selected because the subject crosses archaeology, ethnohistory, colonial and political history, environmental history, geography, ecology, climatology, water governance and contemporary public policy. These bodies of evidence differ substantially in methods and source types and cannot be reduced meaningfully to a single quantitative synthesis.

The bibliographic audit prioritized peer-reviewed literature and authoritative institutional sources. Historical dates and political events were cross-checked against historiography and official documentation where available. Archaeological and heritage claims were checked against IPHAN. Contemporary Indigenous territorial status was checked against FUNAI and the federal decree homologating the Potiguara de Monte-Mor Indigenous Land.

Demographic and territorial statistics were checked against IBGE.

Environmental interpretations were grounded in peer-reviewed literature on Atlantic Forest conservation, Caatinga ecology, drought, land-use change and climate adaptation (TABARELLI et al., 2005; RIBEIRO et al., 2015; ALBUQUERQUE et al., 2012; SILVA; LEAL; TABARELLI, 2017).

The analytical framework integrates four dimensions: historical time; territorial differentiation; socioeconomic systems; and environmental transformation. Environmental conditions are treated as constraints and opportunities mediated by institutions and social relations rather than as deterministic causes.

3 Ancestral Landscapes before European Contact

Archaeological evidence demonstrates that the territory of present-day Paraíba had a substantial human history before European arrival. The Pedra do Ingá (Figure 2), or Itacoatiaras do Rio Ingá, is the best-known archaeological monument in the state. Its engraved rock surfaces contain numerous motifs whose exact chronology and meanings remain debated.

The responsible historical interpretation is therefore not to impose speculative astronomical or linguistic readings, but to recognize the site as evidence of complex Indigenous cultural expression and long-term occupation (IPHAN, 2022; FUNES, 2022).

Other archaeological occurrences, including Indigenous funerary contexts associated with the Aratu tradition, reinforce the diversity of precolonial occupation. The archaeological record also cautions against describing the region encountered by Europeans as empty or untouched. Indigenous populations cultivated plants, fished, hunted, gathered, moved seasonally, used fire and managed useful species. Coastal, riverine and inland environments were cultural landscapes in which ecological knowledge and social organization were inseparable.

Historical sources identify Potiguara populations along the northern coast and Tabajara groups as major actors in the later sixteenth-century conflicts. Colonial writers also used broad labels such as Tapuia for multiple inland peoples, a terminology that often concealed linguistic, political and cultural diversity.

Modern scholarship must therefore treat colonial ethnonyms critically and avoid reproducing administrative categories as if they were precise Indigenous self-identifications (SIMÕES, 2016; VAN DEN BEL; FRANÇOZO, 2023).

A summary of this trajectory is shown in Figure 3.



Figure 2. Pedra do Ingá archaeological site, Paraíba, northeastern Brazil. Adapted from IPHAN (2022) and IBGE (2026).

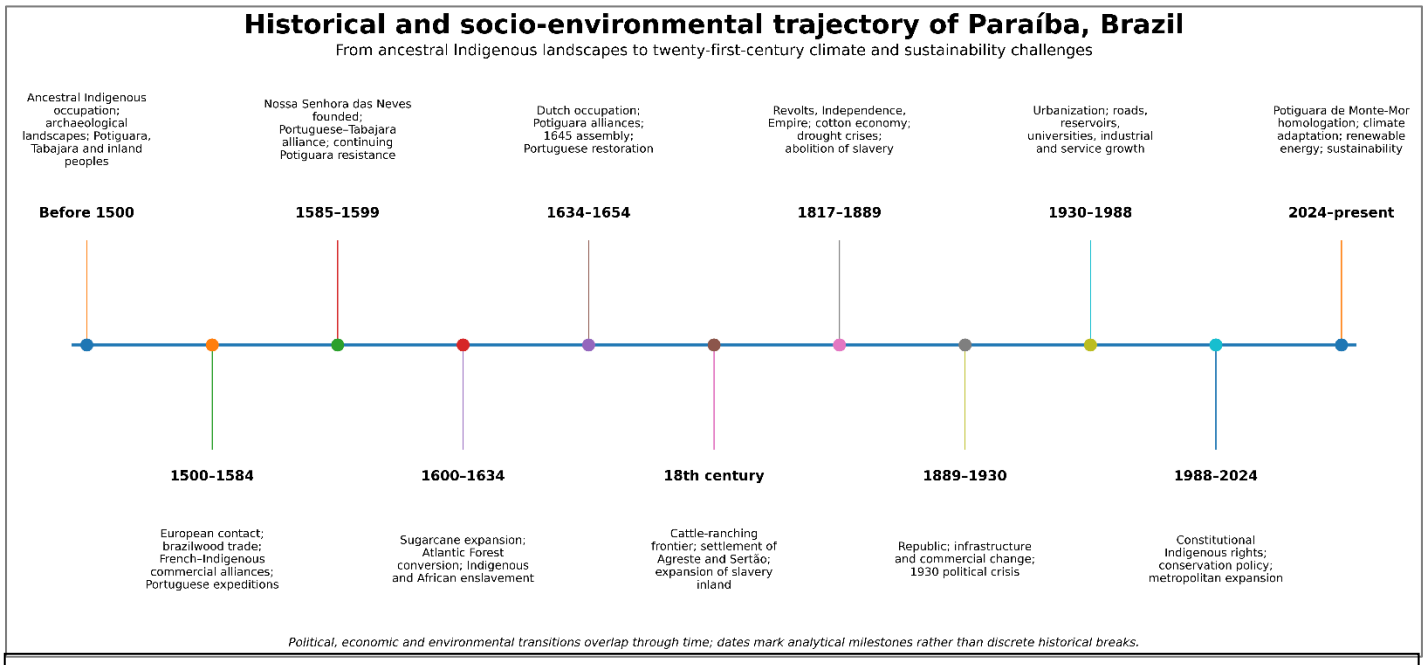

Figure 3. Historical and socio-environmental trajectory of Paraíba, Brazil, from ancestral Indigenous occupation to contemporary climate and sustainability challenges. Dates indicate analytical milestones rather than discrete historical breaks.

4 European Contact, Brazilwood and the Atlantic Frontier

European expansion transformed the northeastern coast into a contested Atlantic frontier. Brazilwood — *Paubrasilia echinata* (Lamarck, 1785) — attracted merchants because of its valuable dye-producing timber. French traders developed commercial relationships with Indigenous groups, including Potiguara communities, exchanging manufactured goods for forest products and assistance in extraction.

These alliances complicated Portuguese territorial claims and demonstrate that early contact involved diplomacy and Indigenous strategic choice as well as violence.

The environmental significance of this phase is substantial. A native Atlantic Forest tree became embedded in an overseas commodity network, linking local ecological knowledge, extraction sites and coastal navigation to European markets.

Resource extraction and imperial competition thus developed together. Portuguese efforts to suppress French commerce were inseparable from attempts to control Indigenous alliances, river mouths and productive coastal landscapes.

5 Portuguese Conquest and Colonial Consolidation

Portuguese attempts to occupy the Paraíba region repeatedly encountered resistance. A decisive shift occurred in 1585, when Portuguese forces consolidated an alliance with Tabajara groups associated in historical accounts with Piragibe and established Nossa Senhora das Neves near the Paraíba River. The settlement later developed into João Pessoa. Yet colonial foundation did not mean immediate sovereignty. Potiguara resistance continued, and the final years of the sixteenth century remained marked by warfare, diplomacy, missionary intervention and shifting alliances (SIMÕES, 2016).

The conquest of Paraíba should therefore be interpreted as a negotiated and violent process involving multiple Indigenous and European actors. This approach avoids teleological narratives in which Portuguese domination appears inevitable.

It also places territorial dispossession at the center of colonial environmental change: the conversion of Indigenous territories into royal grants, plantations, mission settlements and colonial jurisdictions altered both political authority and access to land and resources.

6 Sugar, Slavery and Coastal Environmental Transformation

After Portuguese control became more stable, sugarcane expanded across suitable coastal environments. The plantation economy depended on fertile soils, abundant water, timber, fuel, transport routes, mills, capital and access to Atlantic markets. The engenho was consequently not only a processing facility but a socio-ecological complex that reorganized land, labor, forests and river systems. The broader northeastern sugar economy is well documented as a major driver of colonial landscape transformation (GALLOWAY, 1968).

Atlantic Forest vegetation was cleared for cane fields, settlements, roads and fuel. Timber was required for construction and processing. Rivers facilitated transport and supplied water. The environmental footprint of sugar therefore extended beyond the planted field. In Paraíba, as elsewhere in the northeastern plantation zone, centuries of agricultural conversion contributed to the fragmentation that now characterizes the Atlantic Forest (TABARELLI et al., 2005).

This landscape transformation was inseparable from slavery. Indigenous enslavement and coercive labor occurred during colonial expansion, while the forced migration of Africans became fundamental to plantation production. Enslaved Africans and their descendants shaped Paraíba's demography, agriculture, culture, technology and economy. Scholarship on the northern captaincies also demonstrates that African slavery expanded into inland cattle-producing areas rather than remaining exclusively coastal (GUIMARÃES, 2023).

The joint history of plantation agriculture, slavery and land concentration produced long-term social and environmental legacies. Environmental appropriation generated wealth unevenly, while coerced labor enabled large-scale transformation. This connection is essential to environmental history because landscapes were produced through unequal social relations rather than by abstract economic forces.

7 Dutch Brazil and Potiguara Political Agency

The Dutch West India Company occupied extensive portions of northeastern Brazil in the seventeenth century, and Paraíba came under Dutch control in the 1630s. Sugar-producing territories, ports, rivers, mills and agricultural lands were strategic assets in the conflict. The struggle between Dutch and Portuguese powers was therefore simultaneously military, commercial and environmental (OLIVEIRA, 2021).

Indigenous alliances were decisive and politically complex. Potiguara communities did not form a single bloc. Some leaders and settlements aligned with Dutch authorities while others supported Portuguese forces. The 1645 Tapesserica Assembly is particularly important: 134 Potiguara from settlements across Rio Grande, Paraíba, Itamaracá and Pernambuco gathered to select representatives and negotiate a semi-autonomous political arrangement with the Dutch West India Company (MIRANDA, 2025).

The surviving documentation, including texts associated with Antônio Paraupaba and Potiguara petitions, demonstrates sophisticated Indigenous engagement with colonial institutions and transatlantic diplomacy (HULSMAN, 2006; SILVA; COSTA; MIRANDA, 2024; PAIVA, 2025). These sources require a substantial revision of narratives that represent Indigenous people only as auxiliaries in European wars.

The Paraíba insurrection of 1645-1647 formed part of the broader Portuguese restoration struggle and involved Indigenous leaders on opposing sides, including figures remembered in Portuguese and Dutch alliances (OLIVEIRA, 2021). Portuguese restoration ended Dutch rule but did not reverse the demographic disruption, territorial loss and political reorganization experienced by Indigenous communities.

8 Cattle Ranching, Interior Colonization and the Caatinga

The expansion of colonial society into the Agreste and Sertão created a different socio-environmental regime from the coastal plantation zone. Cattle ranching required extensive grazing areas and became important for supplying meat, hides, transport and draft animals. River valleys and water points structured routes and settlement because water availability was a critical constraint in the semiarid environment.

This frontier was also a zone of Indigenous dispossession and slavery. As ranches and settlements expanded, colonial land claims increasingly overlapped with Indigenous territories. African enslaved labor was present in the sertões of the northern captaincies during the eighteenth century, challenging older historiographic assumptions that slavery was negligible in cattle regions (GUIMARÃES, 2023).

The Caatinga must not be interpreted as an ecologically poor background to this process. It is a highly diverse seasonally dry tropical forest with substantial endemism and distinctive adaptations to water limitation (ALBUQUERQUE et al., 2012; SILVA; LEAL; TABARELLI, 2017). Human occupation generated both degradation and accumulated ecological knowledge.

Livestock, fuelwood extraction, cultivation, hunting and fire altered vegetation, while rural communities developed strategies for water storage, crop timing, animal management and use of native species.

9 Independence, Empire, Cotton and Abolition

Paraíba participated in the political transformations that preceded and followed Brazilian independence. The Pernambucan Revolution of 1817 extended into the province, and the Confederation of the Equator in 1824 reflected regional opposition to political centralization. After independence in 1822, Paraíba became a province of the Brazilian Empire. Political independence, however, did not dismantle slavery, land concentration or commodity-oriented agriculture.

Cotton became especially important during periods of strong external demand and helped connect inland northeastern production to Atlantic markets. Brazil's northern cotton exports had already achieved major international relevance by the late eighteenth century, although taxation and changing competitiveness constrained the sector during the nineteenth century (PEREIRA, 2021). Cotton's suitability for parts of the interior made it an important component of regional commercialization and urban growth.

The abolition of slavery in 1888 was a fundamental legal transformation but did not eliminate inequalities accumulated through centuries of coerced labor, racial hierarchy and unequal land access.

The proclamation of the Republic in 1889 transformed Paraíba from an imperial province into a federated state, while many rural social structures persisted.

10 Drought, Water and Social Vulnerability

Drought is one of the most persistent environmental themes in the history of Paraíba. Rainfall in the semiarid Northeast is highly variable, and prolonged drought can reduce crop yields, forage, reservoir storage and household water availability. Yet climatic drought and social disaster are not equivalent. The severity of human impacts depends on poverty, land tenure, infrastructure, market access, water governance and public policy (MACHADO; DIAS; SILVA, 2017).

Historically, drought disproportionately affected rural populations with limited reserves and political power, contributing to livestock mortality, food insecurity, indebtedness and migration.

Government responses gradually shifted from emergency relief toward hydraulic infrastructure and, more recently, coexistence with semiarid conditions through decentralized water technologies and risk management.

Reservoirs, dams, wells, pipelines and irrigation transformed the hydrological landscape. These interventions reduced some forms of vulnerability but also created new ecological and governance questions concerning allocation, evaporation, water quality, displacement and unequal access.

Current research in the Upper Paraíba basin shows that climate change adds uncertainty to future water availability, reinforcing the need to integrate hydrology, land management and social policy (XAVIER et al., 2026).

11 Republic, the 1930 Crisis and 20th-Century Modernization

During the First Republic, Paraíba remained strongly connected to agricultural economies while experiencing gradual commercial and infrastructural change. In 1930, the state became central to a national political crisis.

João Pessoa Cavalcanti de Albuquerque, president of Paraíba and vice-presidential candidate on the opposition ticket led by Getúlio Vargas, was assassinated in Recife on 26 July 1930 by João Dantas.

The assassination had complex personal and political antecedents and should not be reduced to a single cause of the Revolution of 1930; nevertheless, it was rapidly transformed into a powerful political symbol. The capital, previously Parahyba, was renamed João Pessoa in September 1930.

Across the twentieth century, urbanization accelerated and the spatial organization of the state changed. João Pessoa expanded as the administrative capital and a center of services, education, tourism and commerce.

Campina Grande consolidated its position as a major inland commercial, educational and technological center. Roads, electrification, communications, universities, industry and public infrastructure strengthened regional integration (SILVA, 2005).

Modernization also intensified environmental pressures. Urban expansion converted natural and agricultural land, increased water and energy demand, generated larger waste streams and altered drainage.

Coastal urbanization placed pressure on estuaries, beaches, mangroves and remaining Atlantic Forest.

At the same time, universities and research institutions increased the state's capacity to investigate biodiversity, climate, semiarid agriculture, public health and environmental management.

12 Contemporary Environmental Diversity and Conservation

The eastern portion of Paraíba lies within the Atlantic Forest domain, one of the world's most threatened biodiversity hotspots. Habitat loss and fragmentation are historical consequences of agricultural conversion, timber extraction, infrastructure and urbanization. Remaining forest fragments have disproportionate conservation value because they retain biodiversity within a heavily transformed landscape (TABARELLI et al., 2005).

Mangroves and estuaries provide nursery habitat, fisheries resources, shoreline stabilization, nutrient cycling and carbon storage. In Paraíba, these systems are also cultural landscapes linked to artisanal fishing, shellfish harvesting and traditional livelihoods.

Their vulnerability reflects cumulative pressures from urbanization, pollution, land conversion, port activities and climate-related coastal change.

The Borborema Plateau and Agreste form a transitional mosaic between humid coastal environments and the semiarid interior. Relief modifies rainfall and vegetation, generating local ecological heterogeneity and supporting diverse agricultural systems.

This transitional position also makes the region important for understanding how future shifts in temperature and precipitation may reorganize ecosystem boundaries.

The Caatinga dominates much of inland Paraíba. Contemporary research has overturned older assumptions of biological poverty and documented high floristic diversity, endemism and complex ecological dynamics (ALBUQUERQUE et al., 2012; SILVA; LEAL; TABARELLI, 2017; RAMOS et al., 2020).

However, chronic anthropogenic disturbance can simplify vegetation, reduce phylogenetic diversity and homogenize ecological communities (RIBEIRO et al., 2015; RIBEIRO et al., 2016; RIBEIRO-NETO et al., 2016).

Precipitation mediates many of these effects, emphasizing the interaction between human disturbance and climate (RITO et al., 2017).

Figure 4 presents a historical and socio-environmental overview of Paraíba.

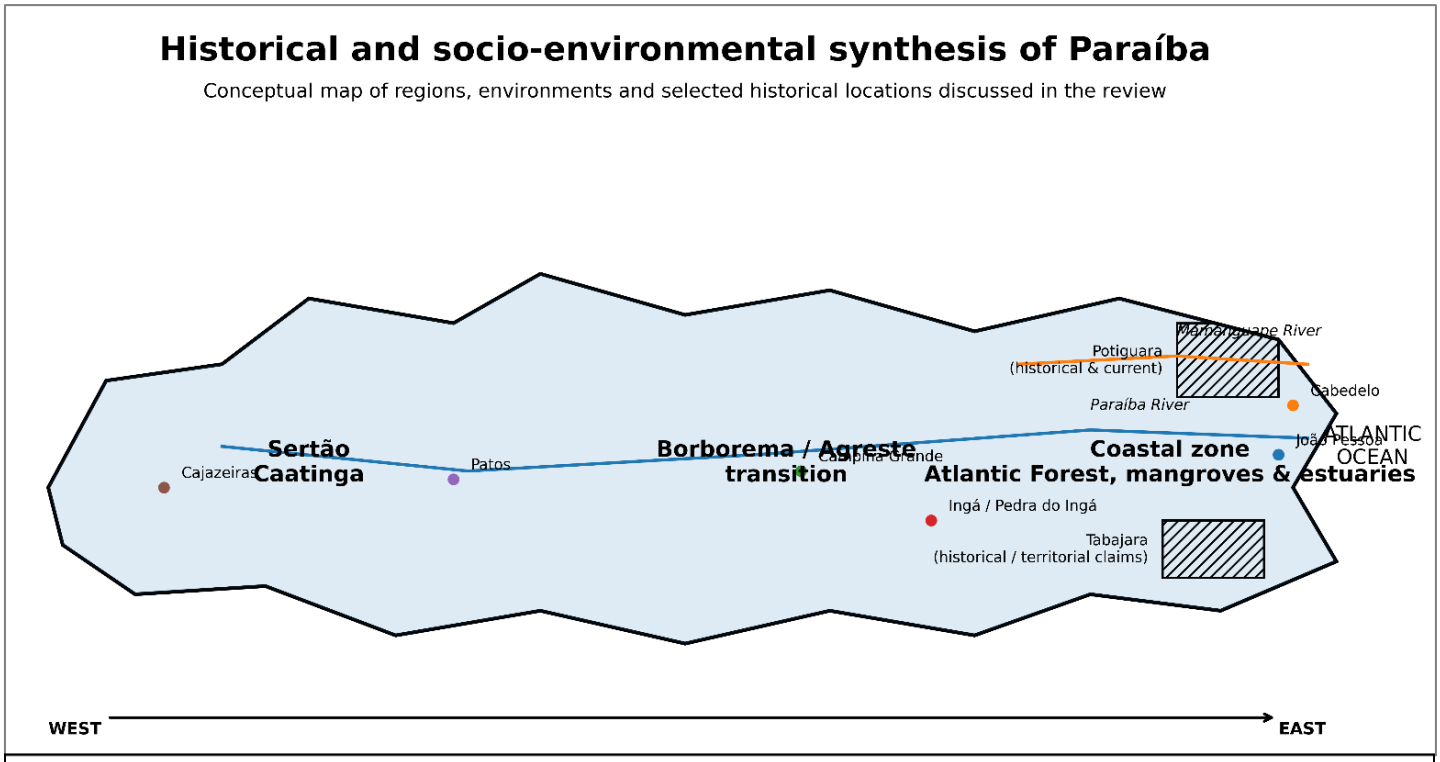

Figure 4. Conceptual historical and socio-environmental synthesis of Paraíba, showing the coastal Atlantic Forest/mangrove zone, Borborema-Agreste transition and semiarid Caatinga, together with selected places discussed. The Indigenous areas are schematic and do not represent legal boundaries.

13 Indigenous Persistence and Territorial Governance

Indigenous peoples remain active political and cultural communities in contemporary Paraíba. Potiguara communities are concentrated particularly in the northern coastal municipalities of Baía da Traição, Marcação and Rio Tinto, while Tabajara communities have pursued territorial recognition and cultural revitalization in the southern coastal region (SIMÕES, 2016; FUNAI, 2024a).

The Potiguara de Monte-Mor Indigenous Land is a major contemporary milestone. Federal Decree No. 12,288 of 4 December 2024 homologated its administrative demarcation in the municipalities of Rio Tinto and Marcação (BRASIL, 2024). FUNAI reports an area of approximately 7.5 thousand hectares, more than 7,000 Indigenous residents in six villages according to 2022 census data, and environments of high ecological interest including Atlantic Forest and mangroves (FUNAI, 2024b; FUNAI, 2024c).

This case illustrates the inseparability of territorial rights and environmental governance.

Indigenous territories are not simply remnants of historical occupation; they are living socio-ecological systems in which identity, food security, biodiversity, subsistence, cultural memory and political autonomy interact. The long demarcation process also demonstrates how colonial and postcolonial land conflicts persist into the twenty-first century (COSTA et al., 2020).

14 Climate Change, Land Degradation and Water Security

Climate change adds a new layer to older environmental vulnerabilities. In the semiarid interior, rising temperatures and increasing atmospheric water demand can intensify evapotranspiration, while changes in rainfall timing and variability affect rain-fed agriculture, vegetation productivity and reservoir recharge.

Recent projections indicate increasing aridity and declining vegetation vigor across parts of the Brazilian semiarid region, including negative responses in Caatinga vegetation under future scenarios (XAVIER et al., 2026; RITO et al., 2017).

Drought and anthropogenic land-use pressures interact.

Remote-sensing studies show strong coupling between Caatinga vegetation activity and rainfall, while land degradation can reduce ecosystem resilience (RITO et al., 2017; RIBEIRO et al., 2015). Chronic disturbance causes biological impoverishment, and conversion to pasture can alter hydrological properties and surface energy exchange (RIBEIRO et al., 2015; RIBEIRO-NETO et al., 2016).

These findings are important for Paraíba because climate adaptation cannot be reduced to emergency water supply. It requires integrated watershed management, soil conservation, native vegetation protection, sustainable agriculture, drought preparedness and equitable water allocation. Ecosystem-based adaptation is increasingly proposed for the Caatinga, but policy fragmentation and social inequality can constrain implementation (SILVA; LEAL; TABARELLI, 2017; MACHADO; DIAS; SILVA, 2017).

Coastal Paraíba faces a different risk profile. Sea-level rise, coastal erosion, extreme rainfall, flooding, salinity changes and altered estuarine dynamics can affect infrastructure, tourism, mangroves and traditional livelihoods (COSTA et al., 2019). Urban inequality can amplify these impacts, as illustrated by socio-environmental vulnerability in precarious settlements of João Pessoa (KLAFKE et al., 2025).

15 Renewable Energy and a New Territorial Transition

The expansion of wind and solar energy in northeastern Brazil represents a new socio-environmental transition. Paraíba has substantial solar and wind potential, and renewable energy can support decarbonization, economic diversification and energy security (ALMEIDA et al., 2023; FERREIRA et al., 2022).

However, renewable infrastructure is not impact-free. Wind projects can create land-use conflicts, landscape alteration, biodiversity effects and uneven distribution of benefits, depending on location and governance (LEITE; PICCHI, 2019). Solar development likewise requires assessment of land occupation, transmission infrastructure, waste management and community participation.

Historical comparison is useful. Brazilwood, sugar, cattle, cotton and hydraulic infrastructure each reorganized relationships among territory, resources, labor and external markets. Renewable energy should therefore be governed with explicit attention to cumulative impacts, territorial rights, benefit sharing and biodiversity conservation so that the low-carbon transition does not reproduce older patterns of unequal resource appropriation.

16 Discussion: Paraíba as a Socio-Environmental Palimpsest

The historical trajectory synthesized here is best understood as a palimpsest: new socio-environmental regimes were layered over older ones without completely erasing them. Indigenous territorialities preceded colonial occupation and persist today. Sugarcane remains important in landscapes transformed during the colonial period. Cattle ranching continues to structure parts of the interior. Reservoirs built to confront drought still define water security. Urban growth expands over earlier agricultural and ecological landscapes.

This perspective rejects environmental determinism. The humid coast did not inevitably produce plantation slavery, and the semiarid climate did not inevitably produce poverty. These outcomes emerged from political economy, institutions, land distribution, labor relations and technology interacting with environmental conditions. The same principle applies to climate change: exposure to drought or flooding becomes socially unequal vulnerability through differences in wealth, infrastructure, rights and political voice.

Indigenous history also changes the temporal architecture of Paraíba. Beginning the narrative in 1585 places Indigenous peoples at the margins of a Portuguese-centered story. Beginning with ancestral landscapes instead makes European colonization one phase within a much longer history and makes contemporary Potiguara and Tabajara communities visible as historical continuities rather than survivals of a vanished past.

Biodiversity conservation likewise benefits from historical analysis. Atlantic Forest fragments record centuries of conversion; mangroves preserve ecological functions and relationships with fisheries; Caatinga landscapes reflect both disturbance and accumulated adaptation to semiarid conditions. Conservation policy should therefore integrate ecological science with archaeology, history, anthropology and traditional knowledge.

The Caatinga literature is especially relevant to future planning. Chronic disturbance can impoverish biological communities, but native vegetation also provides hydrological regulation, microclimatic moderation and carbon storage. Recent research identifies Caatinga as an efficient carbon sink under some conditions while warning that climate-driven aridity and land degradation threaten vegetation vigor and endemic plant diversity (SILVA; LEAL; TABARELLI, 2017; RIBEIRO et al., 2015; RITO et al., 2017).

Protecting native vegetation is therefore simultaneously a biodiversity, water, climate and rural-development strategy.

Finally, environmental justice must be incorporated into sustainability. Urban expansion, renewable-energy projects, conservation measures and water infrastructure distribute costs and benefits unevenly.

The environmental future of Paraíba will depend not only on technological efficiency but also on transparent governance, territorial rights, social participation and equitable access to ecosystem services.

17 Research Gaps and Future Directions

Several research gaps emerge from this synthesis. Archaeological knowledge remains geographically uneven and should be expanded through modern, non-destructive methods and collaborative research. Indigenous histories require greater incorporation of Indigenous authorship, oral history and community archives. Historical ecology could reconstruct land-cover change across the Atlantic Forest-Agreste-Caatinga gradient by integrating archival maps, remote sensing and paleoenvironmental evidence.

Drought research would benefit from linking historical records of migration, crop failure, reservoir construction and relief policy with modern climate reconstructions. Coastal environmental history should connect long-term mangrove change, fisheries, urbanization, port development, tourism and shoreline dynamics. Renewable-energy expansion requires longitudinal socio-environmental monitoring, particularly where projects overlap with rural, traditional or ecologically sensitive territories.

A final priority is the integration of historical inequality into climate-vulnerability assessment. Climate projections identify hazards; history helps explain why those hazards affect communities differently. Interdisciplinary work linking climatology, ecology, geography, public health, anthropology and history can therefore improve both diagnosis and adaptation policy.

18 Conclusions

Paraíba's history extends far beyond Portuguese colonization. Archaeological evidence and living Indigenous communities demonstrate a deep human chronology in which landscapes were inhabited, interpreted and managed before European contact.

Colonial expansion transformed these territories through warfare, alliances, missionary intervention, extraction, plantation agriculture, slavery and incorporation into Atlantic markets.

Sugarcane transformed coastal forests and labor systems; cattle ranching expanded colonial occupation into semiarid landscapes; cotton strengthened market integration; drought exposed the interaction between climate and inequality; hydraulic infrastructure reorganized water governance; and twentieth-century urbanization concentrated population and environmental demand. None of these transitions erased the previous landscape completely.

Contemporary Paraíba now faces a new transition defined by climate change, biodiversity conservation, Indigenous territorial governance, water security, urban sustainability and renewable energy. The 2024 homologation of Potiguara de Monte-Mor demonstrates that historical territorial questions remain central to present environmental governance (BRASIL, 2024; FUNAI, 2024b).

The central lesson of this environmental history is that nature does not determine society. Environmental change acquires social consequences through institutions, power, technology, knowledge and choices. A sustainable future for Paraíba therefore depends on protecting Atlantic Forest remnants, mangroves, estuaries, Caatinga, freshwater resources, archaeological heritage and Indigenous territories while reducing social vulnerability and ensuring equitable participation in development decisions. Historical knowledge is not merely retrospective: it is a resource for designing a more resilient and just twenty-first century.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Conceptualization: DAC; Data curation: DAC, JMLS; Formal analysis: DAC; Methodology: DAC; Project administration: DAC; Writing (primary and review): DAC, JMLS; Validation: DAC, JMLS.

DECLARATION OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

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