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Sight over environmental spending in municipalities in Northeastern Brazil semiarid region

Um olhar sobre o gasto ambiental em municípios do semiárido do Nordeste do Brasil

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Abstract: Increase in public spending aimed at the environment is expected to happen. It will be driven by the global climate emergency and will echo on national and subnational government agendas. This expectation is particularly relevant in Brazil, given its sensitivity to extreme climatic events across the country, such as the semi-arid region, which is mainly exposed to drought and water shortage. Recurrent climatic events have been having impact on municipalities in several regions in recent years, and it highlights the need for higher public investments in climate change mitigation and adaptation actions. Accordingly, the aim of the present article is to analyze public environmental expenditures in 147 municipalities neighboring the Piancó-Piranhas-Açu River Basin in the semi-arid region of Rio Grande do Norte and Paraíba states from 2013 to 2021. The adopted methodology followed the exploratory approach based on secondary data collected from the National Treasury Secretariat (STN) indicator base about expenditures by the investigated municipal governments. Descriptive statistics was applied to variable "total expenditure on environmental spending" and to sub-functions like water resources, preservation and conservation, environmental control and degraded areas recovery. According to the results, there is a worrisome scenario about environmental policy financing at municipal level, which is featured by significant asymmetry and lack of expenditures allocation in municipalities neighboring the Basin. A significant fraction of these municipalities do not register direct expenses with environmental management.

Keywords: municipalities; environmental public policy; municipal environmental expenditure; semi-arid; Piancó-Piranhas-Açu River Basin.

Resumo: Espera-se um aumento dos gastos públicos destinados ao meio ambiente, impulsionado pela emergência climática global e suas repercussões nas agendas nacionais e dos governos subnacionais. Sobretudo no contexto brasileiro, que apresenta áreas sensíveis a eventos climáticos extremos em todo o país, como o semiárido, um território exposto a riscos de seca e escassez hídrica. A sucessão de eventos climáticos que impactou municípios em diversas regiões nos últimos anos sugere a necessidade de um maior investimento público em ações de mitigação e adaptação às mudanças climáticas. Diante deste contexto, o presente artigo tem por objetivo analisar o gasto público em meio ambiente dos 147 municípios que compõem a Bacia Hidrográfica do Rio Piancó-Piranhas-Açu, localizados na região semiárida dos estados do Rio Grande do Norte e da Paraíba, no período de 2013 a 2021. A metodologia adotada foi a pesquisa exploratória, utilizando dados secundários da base de indicadores da Secretaria do Tesouro Nacional (ST) referentes aos gastos das prefeituras investigadas. Foi aplicada estatística descritiva às variáveis despesas totais em gasto ambiental e subfunção: recursos hídricos, preservação e conservação, controle ambiental e recuperação de áreas degradadas. Os resultados revelam um cenário preocupante quanto ao financiamento da política ambiental na esfera municipal, caracterizado por grande assimetria e ausência na destinação dos gastos nos muni-

cípios que compõem a Bacia, sendo que parte significativa deles não registra sequer despesas direcionadas à gestão ambiental.

Palavras-chave: municípios; política pública ambiental; gastos ambientais municipais; semiárido; Bacia Hidrográfica do Rio Piancó-Piranhas-Açu.

1. Introduction

The environmental crisis and its increasing complexity over the last 50 years are putting pressure on national governments at all levels to pay closer attention to their issues in order to prevent or respond to potential disasters. However, increasing public spending on these issues is a significant challenge because increased public spending has impact on governments' budgetary base, and it may lead to varying economic structures.

Overall, government responses and investments to mitigate the environmental crisis have been shaped by external and internal pressure, mainly due to the increasing institutionalization of the environmental debate worldwide.

The Brazilian government faced this very case, since it was influenced by and suffered from pressure put by institutional updates in the international environmental debate, back in the 1970s, when states responses to environmental issues had emerged. The National Environmental Policy (PNMA) was enacted in 1981 by law n. 6,938, which provided on the National Environmental System (SISNAMA), whose creation took into consideration the complexity of addressing environmental issues in a country featured by different biomes; economic, social and political-nature inequalities and by governments' managerial skills, mainly under the military dictatorial regime. However, this scenario changed due to pressure put by social mobilization focused on environmental protection and on natural resources conservation during the country's. The environment was acknowledged as right of citizens after the country's (re)democratization. This concept was ratified by the 1988 Constitution and added to the federal pact, at all governmental levels.

The 1988 Constitution transferred the responsibility and prominence in this changing scenario to the municipal level through decentralization because the Federal Government's power, resources and accountability was passed to other governmental levels. Although the institutional framework proved the federal management's commitment to the environment, actually, this process did not prevent the precariousness of environmental protection structures at local levels and the lack of political will to solve the environmental matter (Carlo, 2006).

The decentralization ideal has been observed in SISNAMA (National Environmental System) structure since its elaboration. Environmental policies are essential to balance the relationship between society and the environment; however, the environmental agenda often does not play key role

in municipal governments' agenda. This trend tends to be higher in medium and small-sized municipalities. Clearly, there is lack of broad Municipal Environmental System implementation in Brazilian municipalities.

The lack of municipal environmental management in Brazil worsens the climate change crisis by increasing the frequency and intensity of extreme events. Governments have not achieved effective disaster risk management and showed little reactive and preventive response skills to reduce vulnerabilities and risks to extreme climatic events, and, consequently, to minimize their impact and reduce their potential damage.

The Caatinga, which is mostly featured by the semi-arid climate, presents physical-natural and socioeconomic features that turn it into one of country's most sensitive areas to climate change among the national biomes given its environmental, climatic and social vulnerabilities, which expose it to the risks and threats of extreme climatic events. Furthermore, this biome mostly comprises medium- and small-sized municipalities that tend to have weak institutional structure and low capacity to respond to environmental challenges.

The political, environmental and climate context in municipalities (the governmental level closest to the territory) imposes the need for taking into account and for having the capacity to act based on environmental and climate agendas. This process targets the effective implementation of public policies aimed at addressing this new reality. Governments are challenged to ensure better natural resources management, to focus on environmental conservation and preservation, as well as to join municipal dynamics based on the three-pronged approach to sustainability, which guides thee development of such policies.

The present study emerged from this challenging context. Its empirical scope encompassed 147 municipalities located in the Piancó-Piranhas-Açu River Hydrographic Basin (PPARHB): 100, in Paraíba State and 47, in Rio Grande do Norte State, which covers the central portion of Rio Grande do Norte State and the Western part of Paraíba State. PPARHB is located in Brazil's Northeastern semi-arid region, which is featured by remarkable climatic variations, besides the historical and secular drought processes and prolonged dry spells typically affecting all municipalities neighboring the basin. PPARHB also includes two important water reservoirs, namely: *Mãe d'água* (PB) and *Armando Ribeiro Gonçalves* (RN). Their course is organized into 11 Water Planning Units (UPH) that extend all the way from the hinterlands to the coast of Rio Grande do Norte State.

An estimated population of 1.406.808 inhabitants benefit from the basin's water resources. Approximately 67% of them live in Paraíba State and 33%, in Rio Grande do Norte State (Instituto Brasileiro de Geografia e Estatística [IBGE], 2022). The vast majority of municipalities (75%) house less than 10.000 inhabitants. Patos (PB) is the city in the basin housing the largest population: 103.000 inhabitants. Sousa, Cajazeiras and Pombal

(PB), and Caicó, Assú and Currais Novos (RN) are other important cities. They are quite representative and important to this region's economy (Comitê da Bacia Hidrográfica do Rio Piancó-Piranhas-Açu, n.d.).

The aim of the present study was to better understand the current status of municipal environmental agendas given the need for featuring the research's empirical scope. Therefore, the goal is to investigate municipalities sensitive and exposed to the risks of extreme climatic events and to their social and environmental vulnerabilities, as well as how these municipalities have driven their spending towards environmentally focused demands in Piancó-Piranhas-Açu River Basin territories.

Furthermore, the current research provides an analysis of these resources' volume, description and allocation, from 2013 to 2021, based on data of municipalities expenditures in the basin provided by the National Treasury Secretariat (STN). The study followed the quantitative methodology based on the exploratory approach and on the use of descriptive statistics and sub-functions (water resources, preservation and conservation; environmental control and degraded-areas recovery) to interpret and analyze total environmental expenditures.

Thus, the article presents five sections: introduction, which presents the study problem and aim; the second section, which presents the natural and socioeconomic features of the assessed area; the third section, which addresses the political-institutional context linked to environmental policies and municipal governments; the fourth section, which describes and analyzes the results; the fifth section provides the concluding remarks. It is important to highlight that this work is one of the research objectives integrated into a larger set of investigations, which is coordinated by the second author. This project's overall goal is to analyze the adaptive skills of municipalities in the Piancó-Piranhas-Açu River Basin territory to climate change.

2. Featuring the Piancó-Piranhas-Açu River Basin

The Piancó-Piranhas-Açu River Basin is one of the largest and most important basins in Northeastern Brazil. It encompasses 147 municipalities (100 in Paraíba State and 47 in Rio Grande do Norte State). The basin is located in the Brazilian semi-arid hinterlands and covers 42.900 km^2. The landscape in this region shows natural features that have straight influence on the region's economy and development (Figure 1).

Municipalities neighboring the basin housed 1,406,808 people based on the 2010 demographic census – 69% of whom live in urban centers and 31% in the countryside. The vast majority of municipalities (73%) houses less than 10.000 inhabitants, whereas only 13 municipalities (9%) house total population larger than 20.000 inhabitants, according to data from the National Water Agency (ANA) published in 2018. Despite the demograph-

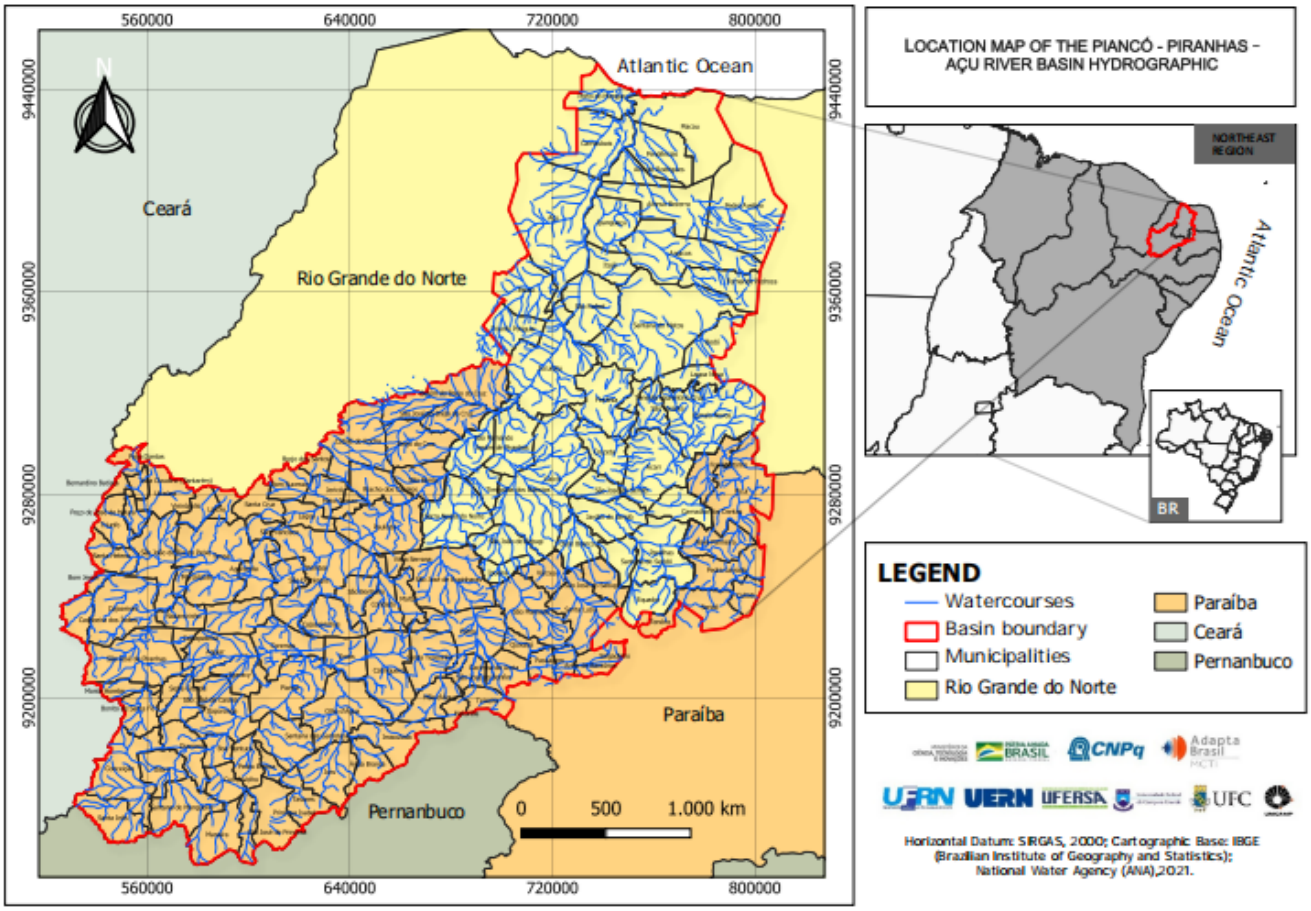


Figure 1

Map of the Piancó-Piranhas-Açu River Basin.

Source: Sistema de Referência Geocêntrico para a América do Sul [SIRGAS], 2000; IBGE, 2019; Agência Nacional de Águas e Saneamento Básico [ANA], 2021 elaborado por equipe do Projeto de Pesquisa, 2021.

ic and socioeconomic growth projections for the last 13 years, the region mostly presents small urban centers and rural areas.

Piranhas River is the main axis of the Basin. It runs through Paraíba State and crosses the border with Rio Grande do Norte State, where its name changes to Piancó-Piranhas-Açu. The basin covers 405 kilometers of federal jurisdiction because it springs in Bonito de Santa Fé municipality (PB) and follows its natural course through Rio Grande do Norte State until reaching the Atlantic Ocean (Ferreira, 2014). The spring of Piancó and Piranhas rivers is located in Paraíba State, where they also meet. They remain as Piranhas River on its way to Rio Grande do Norte State after their confluence. Piranhas River enters Jardim de Piranhas municipality in Rio Grande do Norte State territory and, from this point onwards, it receives the waters from the Espinharas and Seridó rivers, and crosses this State's central region. Piranhas River becomes Açu River after passing through *Armando Ribeiro Gonçalves* dam, where it gets its two main tributaries: Paraú River and Pataxó River, before falling into the sea in Macau City (Agência Nacional de Águas [ANA], 2018).

The river's perennial flow mainly results from the two largest reservoirs in the Basin: *Corema-Mãe D'Água* (PB) and *Armando Ribeiro Gonçalves* (RN). Corema-Mãe D'Água (PB) has maximum storage capacity of 1.36 billion cubic meters and ensures Piranhas River perennial flow for approx-

imately 160 km up to Armando Ribeiro Gonçalves dam, which, in its turn, has the capacity of 2.4 billion cubic meters and regulates approximately 100 km of Piranhas-Açu River up to its mouth (Ferreira, 2014). There are also hundreds of smaller reservoirs that play key role in supplying several communities and rural properties throughout the Basin (ANA, 2018). Water resources availability and management are essential for the Basin's sustainability, although it provides for water supply, irrigation and power generation.

From a natural perspective, the Piancó-Piranhas-Açu River Basin is featured by the combination of coastal plains, plateaus and mountain ranges. The mountain ranges and plateaus are located in its Western and Southern portions, whereas plains and small-slope terrains lay on its Eastern and Northern portions. *Caatinga* is the prevailing vegetation throughout the Basin. It presents hyperxerophilous herbaceous-shrubby features in its Southern part and hypoxerophilous *caatinga* with arboreal growth in areas at the highest altitudes. The most common species distributed in the region are 'catingueira', 'baraúna', 'faveleira', 'jurema', 'marmeleiro', 'pereiro', 'juazeiro' and 'cacti' (*xiquexique, mandacaru, facheiro*). 'Caraibeira' and 'oiticica' are commonly distributed on the riverbanks; 'carnauba' palms are also common in the alluvial deposits, mainly in Lower Açu floodplains. However, the Basin's vegetation cover is mostly changed by anthropogenic activities aimed at agricultural and firewood exploitation. In addition to biodiversity loss, vegetation removal without management criteria exposes the soil to erosion. This occupation pattern has caused damage, some of which irreversible, such as the desertification of hotspots in Seridó region, in Rio Grande do Norte State (Comitê da Bacia Hidrográfica do Rio Piancó-Piranhas-Açu, s.d.).

Part of environmental issues observed in the Basin area regard the degradation of valleys, slopes and riverbeds, and this trend is seen in urban and rural areas due to the search for land occupation. This reality is worrisome because vegetation cover suppression has accelerated erosion processes, siltation, contamination and suspended solids increase in the water. Vegetation accounts for inhibiting or mitigating certain degradations; therefore, whenever it is removed, it has strong negative effects on the quality of the water (Sousa et al., 2014). Most of these issues are closely related to economic sectors established around watercourses throughout the basin.

The region's economic history complies with the reality in most hinterland areas in Northeastern Brazil, which was initially explored in search of gold and precious stones, although the 'eldorado' dream never came true. At the time, people realized that the land's features also impaired agricultural development in the area; therefore, they shifted their focus to livestock farming to supply to the coastal region. This economic cycle emerged from the region's settlement and marked the first record of land environmental

degradation. This process lasted until the late 17th century and declined due to drought periods recorded from 1790 and 1793. Cotton plantations marked the 1800s and reached its peak with 'mocó' cotton crops. This cotton variety is resistant to drought and was well accepted in the foreign markets. Cotton and cattle combination was responsible for strengthening the economy of Upper and Middle Piranhas region from the 19th century to the mid-20th century, and it boosted the development of cities like Cajazeiras, Sousa, Pombal and Patos (PB), and Caicó (RN) (ANA, 2018).

Livestock farming lasted as economic alternative after the cotton decline due to the boll weevil plague and the competitiveness of foreign markets from the 1970s onwards. The region witnessed a restructuring process that broadened its scope to include other animals in its herds, such as goats and sheep. This process was encouraged by governmental incentives and by these states' adjustment to resources available in their semi-arid region. From 1930 onwards, mining became part of Seridó's economic scope, mainly due to the extraction of pegmatites. It was followed by scheelite extraction in Acari and Currais Novos municipalities, Rio Grande do Norte State. Mining reached its peak in the 1970s, but it faced its decline in 1980 due to high production costs and low prices in foreign markets. Economic diversification included boosted shrimp farming in the coastal area (Potiguar coast), which was also responsible for salt production. Investments in water infrastructure were made from 1930 to 1980, and it provided perennial water supply and encouraged irrigated fruit farming, mainly in the early 1980s, particularly in Sousa and Marizópolis municipalities (PB) and in Baixo Açu (RN), downstream *Armando Ribeiro Gonçalves* reservoir, which were the first fruit-growing centers in Northeastern Brazil (ANA, 2018).

Oil and natural gas extraction is another activity deserving attention in the region's economic scope, because Potiguar Oil Basin overlaps the Piranhas-Açu River Basin in the Lower Açu region. Assú, Afonso Bezerra, Alto do Rodrigues, Carnaubais, Pendências, Porto do Mangue and Macau municipalities are close to both basins and they are affected by activities related to this sector. They reap the benefits and impacts of these activities on their economy and environment.

The oil activity in the state started in the 1970s and reached the study site in 1980 after the first wells were drilled in Macau and Alto do Rodrigues municipalities. This sector accounts for considerable impact on the revenues of producing municipalities due to royalties, which reach up to 50% of total revenues in some municipalities. *Alto do Rodrigues*, for example, houses Vale do Açu Jesus Soares Pereira cogeneration thermoelectric plant, which is one of the main projects of the oil sector in the region based on using natural gas for power generation. This activity has aggressive aspects to natural resources, but, on the other hand, oil and its congeners emerge as valuable resources leading to huge economic benefits (Gurgel et al., 2013).

Irrigated agriculture has been adopted as regional developmental strategy and it resulted in a set of irrigation perimeters that operate at different levels of success. The Basin Committee recorded at least 25 irrigated perimeters that have had straight impact on the economy of a large fraction of municipalities in the region (Comitê da Bacia Hidrográfica do Rio Piancó-Piranhas-Açu, s.d.). However, agriculture and livestock farming are the most widespread economic activities in the region, in addition to irrigated fruit growing. There are several areas covered with temporary and permanent crops and pasture. Food crops are cultivated on these areas, with emphasis on subsistence farming (small beans' producers, intercropped corn and extensive livestock farming – cattle and goats) (Sousa et al., 2014).

The Basin's territory has recently stood out for the introduction of new productive activities aimed at exploring and diversifying renewable energy sources to reduce the dependence on fossil fuels and to reduce major greenhouse gas emitters. The Basin area encompasses over 100 wind and solar farms distributed throughout Paraíba and Rio Grande do Norte states. However, these farms have worsened socio-environmental degradation caused by a wide range of socio-environmental impacts affecting populations, fauna and flora. This impact affects municipalities within the Basin and all municipalities currently producing renewable energy sources in the Northeastern region, which is the country's largest wind and solar energy producer (Pessoa, 2022).

The new socioeconomic and water reality also has dangerous consequences. According to Souza et al. (2014), the mean urbanization rate in Piranhas River Basin is close to 72.21%. Overall, this population marks good water supply rates (96%); however, the sewage collection network records very low mean rates: 2.46%, in total. The new scenario imposes a challenge, namely: optimizing the use of stored water and improving production processes' technical aspects. The committee also recognized threats, such as the recent discovery of cyanobacteria blooms in the Basin's reservoirs due to untreated sewage discharge into water bodies. These bacteria can produce toxins capable of contaminating fish and of making them unfit for consumption. The water in the reservoirs is the main, if not the only, water source available for human and animal consumption, and it requires special attention to the environmental sanitation of cities surrounding these waterbodies (Comitê da Bacia Hidrográfica do Rio Piancó-Piranhas-Açu, s.d.).

The Hydrographic Basin area presents anthropogenic activities that have several impacts on both water resources and the soil. Clay (for the ceramics industry) and timber extraction, and agricultural activities have high degradation potential. Signs of waterbodies' poor environmental quality are clear, given the siltation and channels-reduction issue. There was also water quality decrease due to lack of nutrients, reduced biodiversity and riparian vegetation removal. In most cases, changes often come from

native vegetation removal and vegetation cover replacement by other cover forms, such as different paving types, plowed land, agricultural crops and pastures, among others. These changes have straight impact the amount of material carried by rainwater, which washes the surface of loose soils and mix them with several fluids like agrochemicals, urban sewage, industrial waste, leachate and fertilizers, among others (Sousa et al., 2014).

In addition to internal ecosystem complications linked to the region's degradation, the Basin is also affected by global environmental changes, climate change, and, most of all, by global warming, which is constantly reported in the media and has direct implications for the region's environmental features. According to Meira (2020), climate changes affect hydrological projections, since they have impact on the rainy season seasonality. The flow rate can decrease by 15% in the wet season and the flow rate in the dry season reaches 20%, but it will considerably drop down between 2016 and 2035. Such a decrease will compromise the river's intermittency and cast doubt on the region's water availability. This author highlights the study limitations but stresses that simulation results lend credibility to hydrological projections and defines the situation as worrisome. He concluded that the mean flow tends to decrease in the dry season, whereas the maximum extreme flow tends to increase at the same time. This process can lead to hydrological disservice, in addition to create a favorable condition to natural disasters related to floods and droughts in the region.

The Piancó-Piranhas-Açu River Basin is an extremely important site for the Brazilian Northeastern region since it presents different natural features and significant economic potential. The control, preservation and sustainable management of its resources depend on the adoption of responsible economic practices, as well as on the actions taken by local public authorities to ensure the region's socioeconomic development based on their commitment to sustainability.

The global climate scenario poses a major challenge to the region surrounding the Basin, which points towards times of extreme climatic events that could intensify prolonged droughts, a fact that could have straight impact on its territorial configuration. This scenario demands changes in municipal management by the addition of environmental management, and of environmental and climate risk management to institutional scopes, so that they can be observed in the process to plan, develop and implement public policies.

3. Municipalities role in Brazilian environmental policies

Municipalities became a core element in several public policies after the federal changes deriving from the 1988 Constitution. The main change, which was unprecedented at the time, consisted of acknowledging the sovereignty of municipal entities, as shown by Abrúcio (2002, p. 44): "For

the first time in the Brazilian history and without parallel in international experiences, municipalities became federative entities, having the same constitutional legal status as the states and the Federal Government". This author emphasized that the autonomy given to local governments respects a hierarchical line of legal capacity. The Organic Law is the main instrument of municipalities, although it cannot contradict state constitutions. Furthermore, municipalities must follow the limitations set by the Federal Constitution, which gave them a series of specific and shared duties (Abrúcio, 2002).

The 1988 Constitution describes municipal responsibilities in its Article 30 and their shared competencies in its Article 23. The municipal agenda is primarily linked to matters of local interest like legislation, taxation and administrative organization, to territorial planning and to the protection of the historical and cultural heritage, as well as to actions in education and health. The list of shared responsibilities is broad and encompasses social duties, as well as items related to natural and cultural heritage preservation and control; to environmental preservation and to the promotion of housing conditions, basic sanitation and traffic; and to fostering science, technology and food production, among others (Constituição da República Federativa do Brasil, 1988).

The municipal sphere, by its very nature, is the governmental level most closely linked to local demands and, consequently, the one that most clearly reflects the heterogeneity of the national territory among the federated entities. This condition is taken into consideration among transformations brought about by the 1988 Constitution, since it placed municipalities in a position of precedence due to the embedment of a large fraction of governmental initiatives.

However, the heterogeneous nature of the territory does not solely refer to physical and environmental features; the economic and social landscapes are also quite diverse. Rolnik and Klink (2011) stated that the fiscal scenario at municipal level presents large disparities; as a rule, large municipalities have more revenue-raising possibilities, whereas most of the small municipalities depend on state transfers and agreements. Most municipalities resort to access credit from public banks or are at the mercy of voluntary transfers from state or federal governments. This process opens room for a strong dependence relationship set between the local and central spheres, which increases their economic weakness. Although it is important recalling that larger volumes of revenues do not necessarily mean more direct investments in public policies. When it comes to environmental investments, factors like political will and ideology (regarding environmental conservation and preservation) are requirements defining whether or not funding is granted in this area, since it is not a priority agenda for governments. However, it is surrounded by relationships between

political leaders, and social and institutional actors, marked by conflicts and authoritarianism (Ferreira, 1998).

Accordingly, municipalities are often in charge of implementing intergovernmental public policies. However, this competence is extremely uneven due to reasons ranging from the will and political relevance of its rulers, to their technical and financial capacity to hold certain responsibilities (Abrúcio & Franzese, 2007).

Fontanelli (2021) discussed the efforts towards decentralization since the 1988 Constitution enactment. This author highlighted that the federal government started to implement national public policy systems and split the systems into two types: the first one encompasses policies, such as health, which was the subject of constitutional amendments defining entities' participation and link resources in the three governmental levels; the second one includes a wider variety of policies constitutionally defined as concurrent competence. It differs from the first, which is voluntary. However, access to resources is set by the federal government through adhesion formats made available to states and municipalities.

Carlo (2006) highlighted that the most outstanding updates in the decentralization of public policies have taken place in the health, education and social assistance fields. Efforts to split responsibilities in the environmental field remain a major challenge. This scenario also stems from the national political-ideological relationship with environmental issues, which causes environmental public policies to occupy a marginal place on governmental agendas, mainly at state and municipal levels. It is explained by what Ferreira (1998) highlighted as the authoritarian and ideological bias that has always surrounded Brazilian environmental public policies and that does not seem to be changing.

The current study addresses a public policy that falls within the profile of the second national system type described by Fontanelli (2021), namely: National Environmental System (SISNAMA), which holds more uncertainty about resources and responsibilities. Municipalities' participation in this system type tends to be more influenced by local factors and conditions like technical capacity availability, political will and local social preferences.

Arretche (2012) highlighted that the way municipalities operate is strongly conditioned by the analyzed national policy system's institutional arrangement and by intergovernmental relationships forged through federal influence in Brazil. Therefore, it is necessary better understanding SISNAMA (National Environmental System) to actually understand municipal actions in this sector.

The National Environmental System (SISNAMA) was enacted by law n. 6,938/1981, which sets the guidelines for the National Environmental Policy and defines SISNAMA organization and operation (*Lei nº 6.938*, 1981). SISNAMA plays key role in national environmental management by seeking to protect, conserve and recover natural resources, and the en-

vironment, as a whole. It is based on the right to the environment, which was provided for in the Federal Constitution, in its Article 225, according to which, "Everyone has the right to an ecologically balanced environment, [which is] a common good of the people and essential to a healthy quality of life, it imposes on the Public Authorities and the community the duty to defend and preserve it for present and future generations" (Constituição da República Federativa do Brasil, 1988). This excerpt's interpretation gave the environmental issue the status of fundamental right based on the Brazilian constitutional law.

The system comprises bodies and entities responsible for protecting, conserving and for sustainably using natural resources. These entities were divided into three levels: Government Council, which works as superior body and is responsible for advising the President of the Republic on the formulation of national policies and governmental guidelines aimed at the environment; the National Council for the Environment (CONAMA), which works as advisory and deliberative body, and is responsible for proposing standards and criteria for the sustainable use of natural resources, as well as deliberates on environmental quality standards and on licensing for potentially polluting activities; and the implementing bodies, which are state and municipal agencies responsible for implementing environmental policies – it is coordinated by the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), which also has national-level inspection and licensing responsibilities (*Lei nº 6.938*, 1981).

None of the three governmental levels has exclusive responsibility for acting in environmental policies. Therefore, the way states and, most of all, municipalities have responded to demands of the environmental agenda tends to be quite different. Back in 2011, the National Congress approved Complementary Law n. 140, which provided on frameworks for the role of municipalities in environmental management based on constitutional principles. It established four important aspects: first, it is necessity; second, it complies with precepts in law 6.938/81, which deals with the National Environmental Policy; third, the municipality legislates without conflicts of competence with the state and the Federal Government; and finally, local peculiarities must be observed (Vieira & Batista, 2023).

Carlo (2006) pointed out that, overall, municipalities use legal instruments like Organic Law, Master Plan, Multi-Year Plan (PPA), Budget Guidelines Law (LDO), Annual Budget Law (LOA), Tax Code; Municipal Land Use and Occupation Law, Land Subdivision Law, and Municipal Environmental Agency, Municipal Environmental Council, Municipal Environmental Fund. Since most municipalities have little institutional and financial capacity to fulfill new duties and responsibilities, the use of different instruments can change depending on the specific features of each one of them. It often leaves doubts about their scope of action in environmental management.

Law n. 140/2011 established that the municipality may address important matters for the management of the local environment within its exclusive legislative competence. There are no conflicts with state or federal legislation. According to this delegated competence, the municipality must act as decentralized agent of power given to the state in its original form, but which is conferred upon the municipality, so that environmental management can be carried out from the perspective of the interested party, which, in these cases, is the community itself (Vieira & Batista, 2023). Thus, municipalities are fully co-responsible for the environmental mandate, in addition to being the exclusive holders of fundamental responsibilities for environmental quality (Pereira & Figueiredo Neto, 2020).

Municipal institutional arrangements emerged from this perspective. They are responsible for ensuring participation in and implementation of environmental policies at municipal level. The need for financing these policies also arises from duties inherent to public environmental policies. Pereira and Figueiredo Neto (2020) observed that these resources can derive from different sources (financial compensation, agreements, donations, loans, fines, ordinary treasury resources, fees, among others), and they can vary depending on the state policy adopted at federal, state and municipal level. This authors explained that Ordinance n. 42/1999 issued by the Ministry of Budget and Management, which standardized resource allocation for public spending on environmental issues and broadened the possibilities for analyzing sector policies. Public sector budget allocations have several classifications, one of them is the expenditure by function. The Ordinance has set that this description should have higher aggregation level of expenditure areas falling under the public sector's purview – they are subdivided into sub-functions. The sub-functions of function 18 (Environmental Management) are environmental preservation and conservation, recovery of degraded areas, environmental control, water resources and meteorology.

Environmental spending at municipal level also requires regulatory frameworks to guide environmental management decentralization. CONAMA Resolution n. 237/1997 provided on the possibility of transferring powers to municipalities, on authorizing them to carry out the licensing and inspection of activities with local impact. Furthermore, regulation encourages the creation of municipal environmental councils with deliberative character and demands qualified professionals within local administrations (*Resolução CONAMA nº 237,* 1997). Thus, municipalities form their own institutional arrangements, which account for organizing social participation mechanisms and the implementation of environmental policies within their territory.

The need for operating and making this entire institutional framework functional demands public funding. The historical funding of environmental policies in the country still falls short of the sector's needs. Public

spending is essential to the implementation of public policies. A minimum level of funding is necessary to achieve institutional objectives (Borinelli et al., 2017).

Borinelli et al. (2017) reported that, between 2002 and 2012, environmental spending by the Brazilian public sector grew by approximately 30%; it increased from R$9 billion to R$12.5 billion. They explained that the federal government and municipalities experienced environmental spending growth by 9% and 42%, respectively, in their study, which focused on analyzing state-level government spending. States, in their turn, reduced their spending by 2%. They also pointed asymmetries in spending distribution analysis; some states spent a lot and others very little. Overall, there is the tendency for higher spending in Southeastern Region states driven by São Paulo State. Rio Grande do Norte and Ceará states stand out when spending is proportional for the states' GDP: 1.4% and 1.2%, on average, respectively. However, it is estimated that approximately 61% of environmental expenditures fall under the water resources sub-function. This value is higher than the mean expenditure recorded for the Northeastern region (50%). This spending allocation to water resources is explained by recurring drought and water scarcity processes in the Northeastern region, which is almost entirely under the semi-arid climate. It is featured by strong climatic variability and results in low rainfall in this region.

Results variability was detected in research on state-level government spending. Therefore, spending can be influenced by factors ranging from socioeconomic and institutional aspects to political, environmental and geographical issues.

Pereira and Figueiredo Neto (2020) addressed the municipal sphere in a recent time frame (from 2005 and 2015). They focused municipalities with population bigger than 100.000 inhabitants. In 2005, 19.47% of the 303 analyzed municipalities did not allocate funds to Environmental Management and 23.43% of them allocated very low amounts to it. Although the analyzed series showed improved indices over this time, the trend remained the same up to 2015. These authors observed gradual increase in environmental spending on a yearly basis, but they emphasized that a significant number of municipalities do not even spend resources with it, despite the positive fluctuations and responsibilities inherent to their participation in the PNMA (National Environmental Policy).

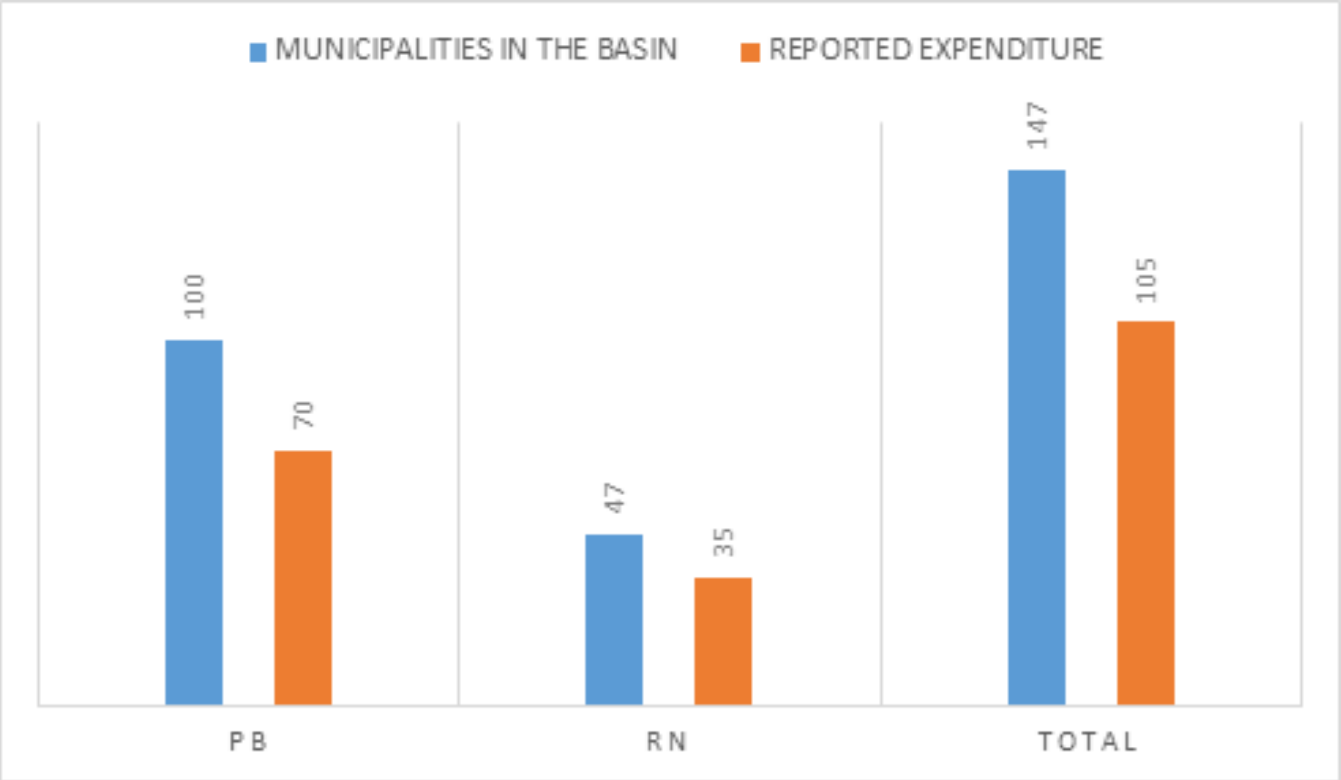
They also highlighted that their research had limitations regarding restrictions in values reported by the assessed municipalities. Some of them did not provide their data, others reported zero environmental spending, which made it impossible to find a homogeneous pattern in public environmental spending, since heterogeneity in public budget application is the main feature of Brazilian municipalities. Public programs and policies depend on the focus given by the public administration in office (Pereira & Figueiredo Neto, 2020).

The influence of socioeconomic, geographic and political issues on resources allocation for environmental agendas is observed in both approaches. One of them addresses municipalities through a population-based approach, which reflects on municipalities' size, revenue and, consequently, on their institutional and political capacity to participate in environmental policies. The current study proposes a geographic approach based on natural, socioeconomic and climatic features to justify its approach and discussions on this topic. It also aims at exploring environmental policies in small municipalities, which are more representative in the empirical field of the research project analyzing it.

Carlo (2006) pointed out that municipalities are a fundamental element for SISNAMA (National Environmental System) consolidation. This system was created to take into consideration the complexity of environmental issues in a country featured by economic, social and political inequalities; and by the nature of its governmental managerial capacity. Aspects like local governments' high sensitivity to the understanding of environmental realities and problems, society protection against excessive power centralization and more opportunities for societal participation in decision-making processes are other stressed elements. When it comes to the environment, these arguments are particularly relevant in regions where the use of natural resources has straight effects on the population's lives.

Environmental issues have strong impact on individuals' living conditions, mainly in the herein assessed region, whether through the economy, water supply, food production or even through the control and mitigation of environmental damage and exposure to climate change risks. The Piancó-Piranhas-Açu River Basin holds an important water reserve in the middle of the semi-arid region in two states that, in addition to drought issues, show economic performance below the national average. Therefore, it is clear that the effective participation of municipalities making up the Basin region in environmental policies is of paramount importance, since decentralized environmental management allows more effective and appropriate actions tailored to regional peculiarities. This is the way municipalities can help developing environmental policies closer to local needs and realities in order to achieve the conservation and sustainable development of natural resources.

Environmental spending will be introduced in the following section as performance indicator of municipalities forming the Piancó-Piranhas-Açu River Basin in environmental policies. Inferences about municipalities' actions could be made based on the collected data due to the challenges and needs inherent to the given natural, socioeconomic and climatic contexts.



4. Result analysis and discussion

Figure 2

Municipalities in the Piancó-Piranhas-Açu River Basin reporting environmental expenditures (2013-2021).

Source: Adapted from the Secretaria do Tesouro Nacional [STN], 2023.

Analyzing municipal environmental spending can be an important input to assess how much is spent on this public policy type. According to the results, there are worrisome scenarios regarding municipal public spending with the environment. A significant portion of the 147 municipalities did not register any environmental spending type between 2013 and 2021. Only 70 of the 100 municipalities forming the Basin in Paraíba State registered some sort of spending type. Only 35 of 47 municipalities registered environmental spending in Rio Grande do Norte State (Figure 2).

In total, 105 municipalities reported some type of expenditure on environmental management, and this number represents 71.4% of the total participants; and 42 of them did not register any expenditure type, which corresponds to 28.6% of municipalities. Municipalities low participation in environmental spending was also reported by Pereira and Figueiredo Neto (2020), who addressed 303 municipalities holding more than 100.000 inhabitants throughout Brazil. Their rates were lower than those found in the present research. However, it is necessary bearing in mind that all municipalities forming the Piancó-Piranhas-Açu River Basin have population smaller than 100.000 inhabitants, and 73% of them do not reach the mark of 10.000 inhabitants, which results in lower revenues and, consequently, in lower capacity to spend on environmental expenses. Based on this analysis' results, it is possible stating that environmental expenditures tend to be low, regardless of whether a municipality is small, medium or large-sized. This hypothesis complies with the fact that the environment occupies a marginal place in governments' public policies, at least in Brazil.

Difficulty in accessing actual spending data related to the environmental field is another important aspect pointed out in the research by Pereira and Figueiredo Neto (2020). It is still observed even after Ordinance n. 42/1999 by the Ministry of Budget and Management, which standardized resource allocation for public spending on the environment. The aforementioned authors stated that heterogeneity in public budget application is the main feature of Brazilian municipalities and that the focus given to programs, actions and public policies depends on the perspective adopted by the administration in office.

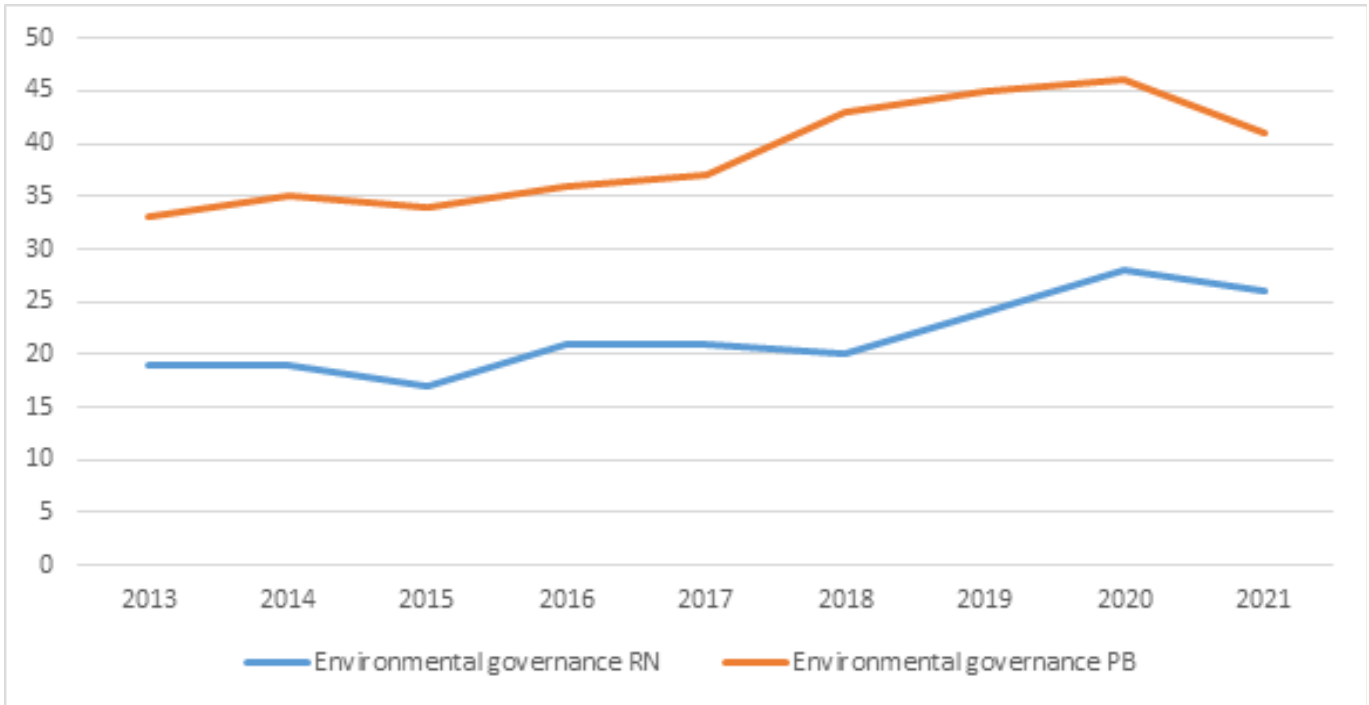
However, the recorded rates are significant, which makes it clear that environmental policies do not occupy a prominent place on municipalities' public spending agendas in this region. This finding goes against the panorama pointed out in the literature, which discloses environmental risks and economic dependence on natural resources at risk. Lack of frequent environmental spending registers in the region raises doubts about municipalities' condition to join SISNAMA (National Environmental System). According to Carlo (2006), municipalities' participation in the System regards the availability of institutional arrangements focused on this sector, such as environmental bodies, councils and funds. If a large fraction of municipalities does not register expenses condensed into another public spending function, whether because of some gap or due to some technical aspect of these arrangements' administrative costs, the question remains: how have the financing of core activities developed by these departments been accounted for?

Figure 3 addresses how often data of municipalities forming the Basin about environmental spending during the assessed time frame are recorded.

Figure 3

Number of municipalities in the Piancó-Piranhas-Açu River Basin recording environmental expenditure on a yearly basis in Rio Grande do Norte and Paraíba states (2013-2021).

SOURCE: Adapted from the STN, 2023.



It is necessary taking into account that Paraíba State has 100 municipalities located in this region (70%) and Rio Grande do Norte has only 47 (30%). Thus, although the absolute numbers show Paraíba's best performance, with yearly mean rate ranging from 35 to 45 municipalities, Rio Grande do Norte performed better, as it kept mean rate ranging from 20 to 28 municipalities. More than half of participants reported environmental spending between 2019 and 2021.

According to the results, environmental spending followed the same growth trend from 2018 to 2020 and decreased in 2021, despite the difference in the numbers recorded in the two states. There was a difference in 2014, when Paraíba State recorded a slight growth in it and Rio Grande do Norte State's numbers remained stable. In 2015, both states showed a small decrease in their rates, and it was followed by a slight increase in them, back in 2016. Both states have recorded some decrease in the last two years, and it is slightly higher in Paraíba State. This time frame corresponds to the two most severe Covid-19 pandemic years, which had straight impact the revenues at all governmental levels and required focus on health and social assistance policies. This finding points towards the relevance of assessing post-pandemic data to determine whether the analyzed states still keep the same spending trend.

Environmental spending uncertainty is another element highlighted in Figure 3. The fluctuating number of municipalities recording yearly spending is striking, and it points out lack of regular expenditure in some municipalities. This scenario, in association with data in the previous figure, shows that 32% of municipalities did not record spending in any of the assessed years. This finding reinforces the uncertainty scenario surrounding environmental investments at municipal government level.

The following figures show these environmental expenses in order to help better understanding the volume, distribution and allocation of these expenditures. The research focused the sub-functions of function 18 (Environmental Management) to conduct this analysis. According to Brazil (1999) and to Ordinance n. 42/1999, these sub-functions are divided into environmental preservation and conservation, environmental control, water resources and meteorology. Expenditures screening was carried out by taking into consideration only liquidated expenses, in other words, those that have already been paid and effectively applied.

Figure 4 shows the expenditures related to the environmental preservation and conservation sub-function in Rio Grande do Norte State. Expenditures in this category totaled R$ 31.829.344. The 27 municipalities in Rio Grande do Norte recording expenditures were Alto do Rodrigues, Caicó, Ouro Branco, Bodó, Pendências, São João do Sabugi, Paraú, Assú, Carnaubais, Currais Novos, Ipueira, São Fernando, Parelhas, Lagoa Nova, Serra Negra do Norte, Carnaúba do Dantas, Macau, Timbaúba do Batistas, Cruzeta, and Cerro Corá.

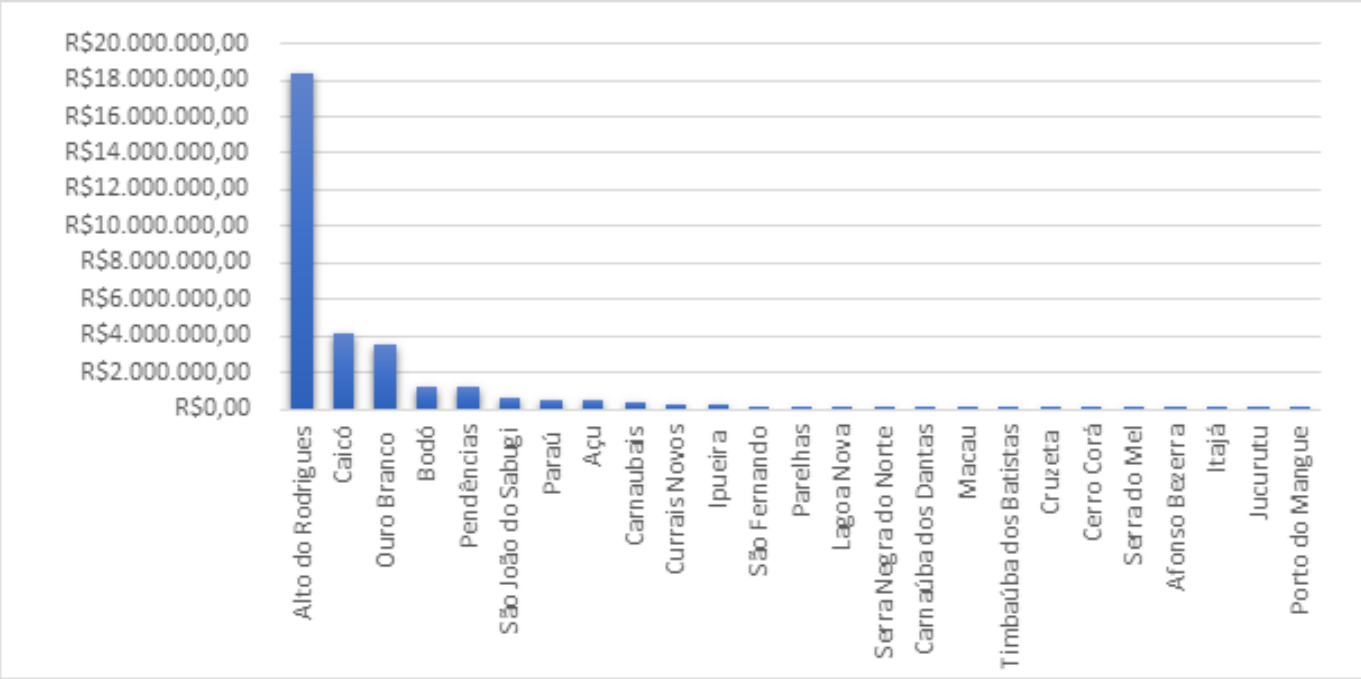


Figure 4

Description of the total spent on preservation and conservation by municipalities making up the Piancó-Piranhas-Açú Basin in Rio Grande do Norte between 2013-2021.

SOURCE: Adapted from the STN, 2023.

According to Figure 5, Alto do Rodrigues municipality stands out for the total spending in environmental preservation and conservation, it exceeded R$ 18 million, which even surpasses the sum of all other 25 listed municipalities, altogether. Porto do Mangue, on the other hand, recorded the lowest spending, only R$3,585.00. These two municipalities show the extreme disparities, which are constantly observed in the analysis. Caicó, Ouro Branco, Bodó and Pendências municipalities presented spending higher than R$ 1 million, whereas Cerro Corá, Serra do Mel, Afonso Bezerra, Itajá and Jucurutu recorded spending lower than R$20,000. It is important highlighting that Alto do Rodrigues municipality presents a differentiated economic dynamic in comparison to the group of analyzed municipalities.

The total of spending in Paraíba State is low: R$ 20.505.940, in total, but its distribution is clearer, since it reaches 43 different municipalities. The disparity between municipal spending is also smaller among municipalities; Tavares municipality stands out among the others because it recorded spending of R$ 3.445.349. Five other municipalities had recorded spending higher than R$ 1 million, namely: Água Branca, Santana dos Garrotes, Manaíra, Itaporanga and Maturéia. Cajazeirinhas, Poço Dantas, Passagem, Cacimba de Areia, Piancó, Vieirópolis and Mãe d'Água municipalities, on their turn, showed very low spending, less than R$ 5,000, as it can be seen in Figure 5.

Patos, Sousa and Cajazeiras municipalities, which economically polarize the region, recorded performance below expectations; their spending was well below that of very small municipalities like Santana dos Garrotes, which has just over 6,000 inhabitants and presented the third highest expenditure in environmental issues. The results have disclosed a reality, according to which, municipalities' population size and economic condition

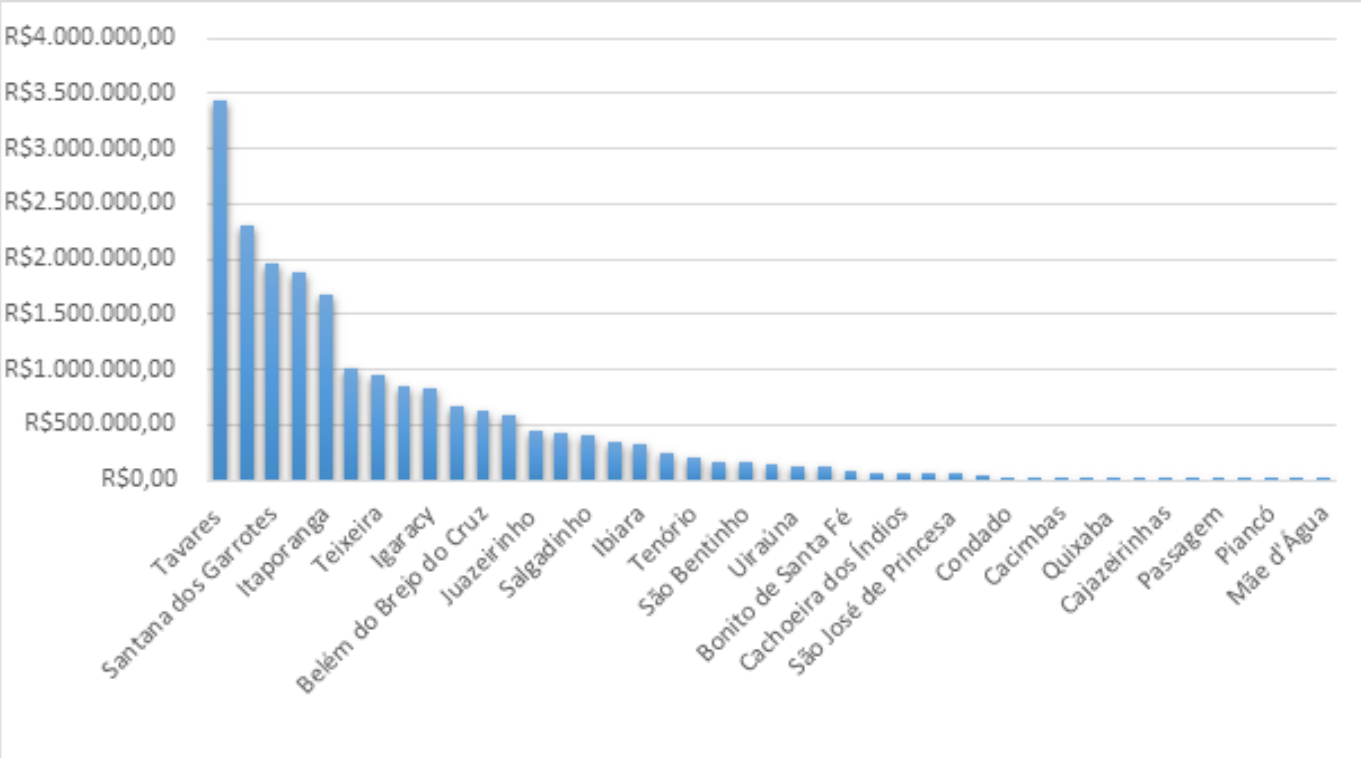


Figure 5

Description of the total spent on preservation and conservation by municipalities making up the Piancó-Piranhas-Açu River Basin in Paraíba State.

SOURCE: Adapted from the STN, 2023.

do not seem to influence the total spending in preservation and conservation. A similar trend was observed in Rio Grande do Norte State, whose Ouro Branco and Bodó municipalities showed much higher spending than municipalities like Assú, Currais Novos and Macau, which are larger and more economically relevant.

Figure 6 shows expenditures linked to the environmental control sub-function only in Rio Grande do Norte State, in the following municipalities: Ipanguaçu, Parelhas, Ipueira, Assú, Jardim de Piranhas, São José do Seridó, Jardim do Seridó, Pendências, Santana do Mato, Cerro Corá and Acari.

Ipanguaçu municipality stands out for accumulated spending exceeding R$ 4.5 million in this sub-function; it surpassed the total amount recorded for the other mentioned municipalities. This municipality is located downstream Armando Ribeiro Gonçalves Reservoir and has agriculture as one of its main economic drivers, mainly the irrigated fruit farming in the Baixo-Açu perimeter, which, according to the Basin Committee, is the largest fruit farming in the region (100% of its territory is already planted) (Comitê da Bacia Hidrográfica do Rio Piancó-Piranhas-Açu, s.d.).

Expenditure in this sub-function covers 12 municipalities, and this number corresponds to 26% of the 47 municipalities in Rio Grande do Norte State located in the Basin. Expenditure distribution is diverse and takes place in municipalities located in the Seridó and Baixo-Açu regions. However, expenditures on environmental control should be higher, more frequent and strategically distributed based on the needs and relevance of natural resources, if one bears in mind the environmental issues pointed

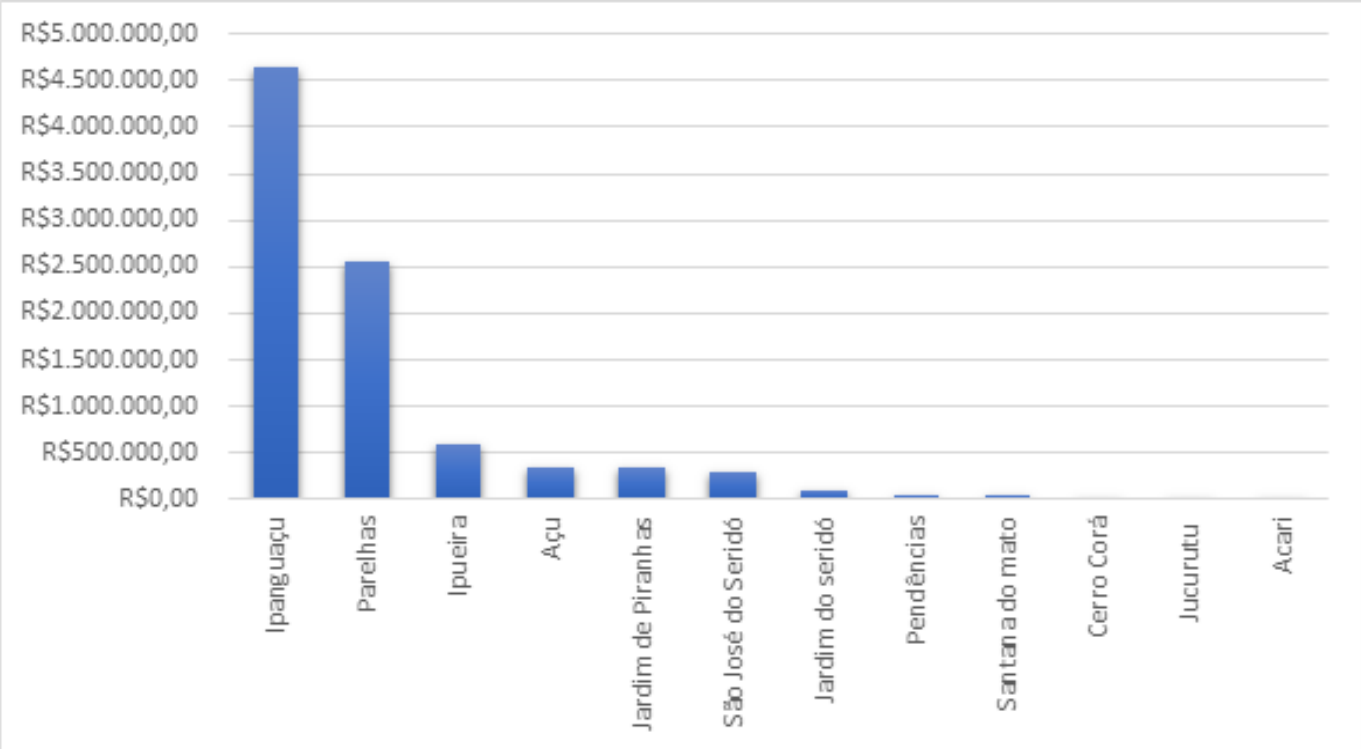


Figure 6

Description of the total spent by municipalities on environmental control in the Piancó-Piranhas-Açu River Basin, in Rio Grande do Norte State.

SOURCE: Adapted from the STN, 2023.

out in the literature, which involve native vegetation and riparian forest degradation, siltation and desertification, among others.

The analysis focused on Paraíba State based on sub-function 'environmental control' (Figure 7) showed that expenses were recorded in the following municipalities: Patos, Vieirópolis, Sousa, São José do Sabugi, Piancó, Boa Ventura, São Francisco, Lagoa, Condado, São José da Lagoa Tapada, São Mamede, Aparecida, Bernardino Batista, São Domingos, Santa Luzia, Bom Sucesso, Tenório, Olho D'água, São José de Piranhas and Quixaba.

Spending in this sub-function only covers 20 municipalities in Paraíba State. If one keeps in mind that the basin encompasses 100 municipalities in this state, this number is very low, since it corresponds to 20% of the total. The total of resources is slightly higher, and they are driven by the total spent by Patos municipalitiy, which is followed by Vieirópolis and Sousa municipalities. However, the mean spending is low when other municipalities are taken into account.

Similar to what happens in Rio Grande do Norte, the total of resources shows large disparity between municipalities in Paraíba State. Patos municipality stands out for registering expenditures higher than R$ 6 million, which is well above the others. This municipality is the most populous in the Nasin (over 103,000 inhabitants) and it also provides the municipality with higher revenues and investment capacity. According to IBGE (2022), the city is second in the state in basic sanitation implementation – 81.61% of households have sewage disposal through a general network, a rainwater network or a septic tank connected to the network. This scenario may influence the total spending in the environmental control sub-function.

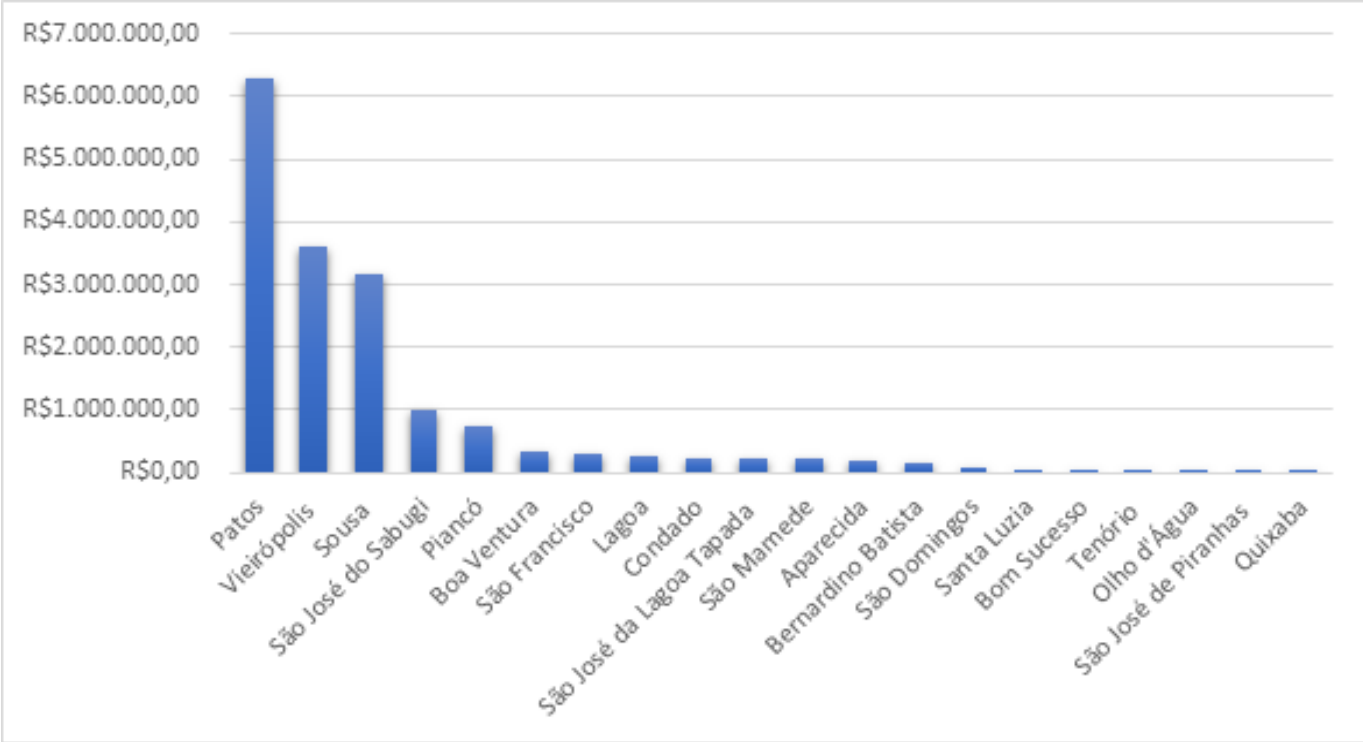


Figure 7

Description of the total spent on environmental control by municipalities in the Piancó-Piranhas-Açu River Basin, Paraíba State.

SOURCE: Adapted from the STN, 2023.

Spending in sub-function 'recovering degraded areas' shows the most critical results. Only four municipalities in Rio Grande do Norte State register expenditures in the environment: Currais Novos, Caicó, Ipueira and São Fernando. The total of resources spent is also very small in all municipalities. Currais Novos municipality recorded the highest expenditure, although still below R$ 25,000 (Figure 8).

All municipalities recording expenditures in this sub-function are located in the Seridó region – RN, which, according to documentary sources, suffers from desertification processes. Currais Novos municipality showed the highest expenditure on this sub-function; it is one of the largest municipalities in the region and, according to the Basin Water Resources Plan (ANA, 2018), its territory is located within what the document defined as Seridó Desertification Nucleus. It also presents large areas of exposed soil, which may require more investments in degraded areas recovery. However, given the analyzed time interval, the total of resources invested in this sub-function is disproportionate to the problem stressed in the Plan.

Besides desertification, the literature on this topic has pointed towards several environmental issues that could be the target of investments in degraded areas recovery. Riparian forests restoration, erosion processes containment and native vegetation restoration are necessary measures in various sections of the Basin; however, there is no record of spending in this sub-function in Paraíba State or in most municipalities of Rio Grande do Norte State.

Figure 9 shows the expenses recorded in Angicos, Currais Novos, São João do Sabugi, Itajá, Carro Corá, São Vicente, Jucurutu, Messias Targino,

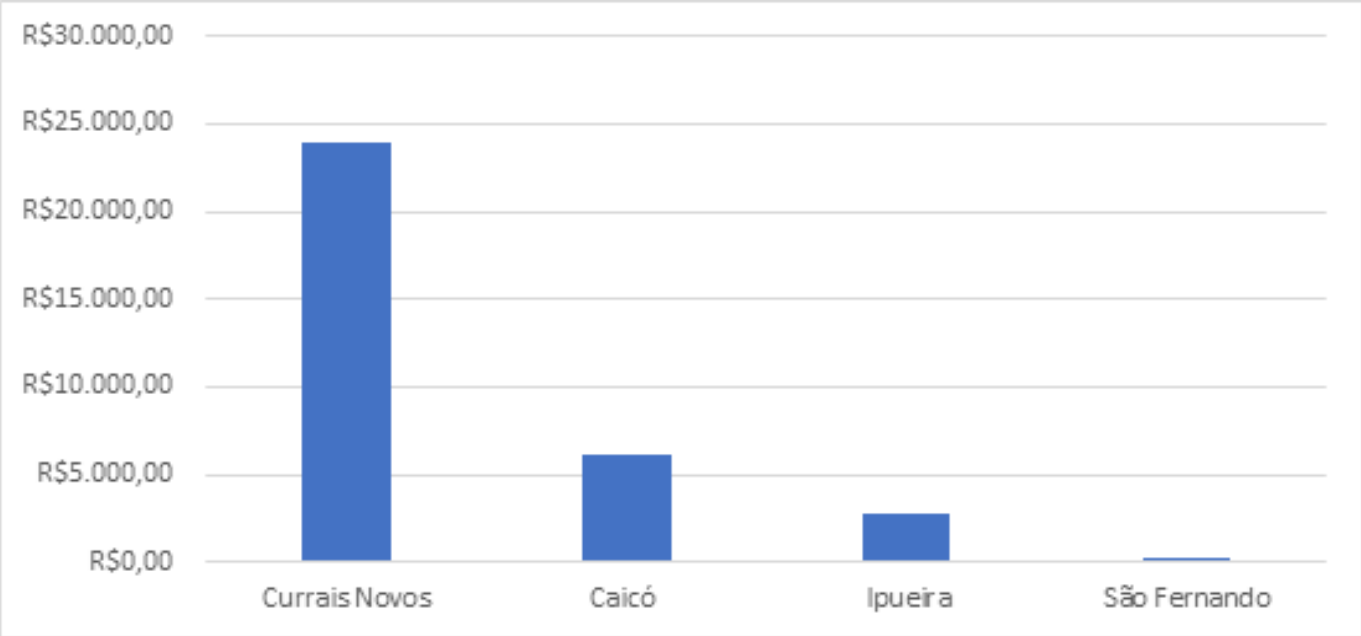


Figure 8

Total spent on degraded areas by municipalities in the Piancó-Piranhas-Açu River Basin, Rio Grande do Norte State.

SOURCE: Adapted from the STN, 2023.

Jardim do Seridó and Tenente Laurentino Cruz municipalities in the water resources sub-function, which totaled 10 municipalities, or 21.3% of municipalities in Rio Grande do Norte State located in the Basin.

The total of resources invested in this sub-function is proportionally low, it only exceeds the total recorded for the degraded areas sub-function. Angicos municipality stands out for total expenditure of R$ 1.4 million. Messias Targino, Jardim do Seridó, and Tenente Laurentino Cruz municipalities, in their turn, showed expenditures lower than R$ 10,000. Angicos is located in one of the driest regions of the state and is historically known for facing difficulties in keeping water supply in much of its territory. Expenditures in this sub-function may be related to initiatives to fight drought effects.

Borinelli et al. (2017) addressed environmental spending at state government level and recorded mean expenditure of 50% on the water resources sub-function in Northeastern states; it reaches 61% in Rio Grande do Norte. Although, according to the results, this trend is not repeated in the Basin's municipalities, this scenario helps explaining that prioritizing investments in this sub-function in common in the Northeastern region. Despite having thousands of reservoirs, including the Armando Ribeiro Gonçalves reservoir (with total capacity of 2.4 billion cubic meters), achieving water security remains a goal pursued by communities in several municipalities forming the Basin. The Basin's Water Resources Plan (ANA, 2018) recognizes supply systems' vulnerability and the need for investing in infrastructure to ensure water supply. Furthermore, evapotranspiration is a very strong phenomenon causing significant loss of water resources. It is also important highlighting that (during the analyzed water expenditure time) the Northeastern region experienced a prolonged period of hydrological drought between 2012 and 2017, whose effects persisted with low

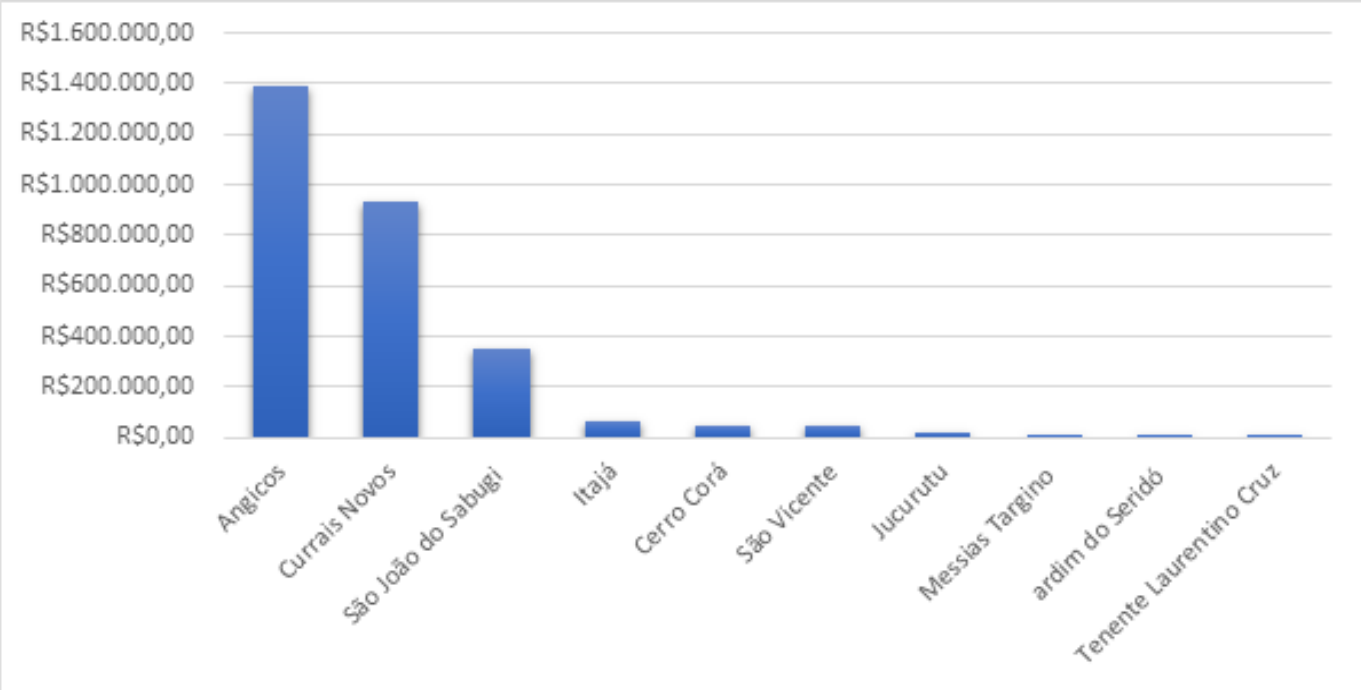


Figure 9

Description of the total spent by municipalities in water resource areas in the RN basin.

SOURCE: Adapted from the STN, 2023.

rainfall volumes between 2018 and 2021. Only the rainy season in 2014, which began in March, managed to fill some of the main reservoirs of municipalities forming the Basin in Rio Grande do Norte State. These factors have contributed to the higher total of expenditures on water resources.

The analysis applied to the water resources sub-function in Paraíba State showed a much higher frequency in expenditures in 35 municipalities: Ibiara, Itaporanga, São José de Piranhas, Santana de Mangueira, Emas, Serra Grande, Manaíra, Bonito de Santa Fé, São Bento, Poço de José de Moura, Poço Dantas, Santa Luzia, Bernardino Batista, Brejo do Cruz, Cajazeiras, Conceição, Bom Sucesso, São José do Sabugi, Pombal, Taperoá, Água Branca, Bom Jesus, Cacimbas, Curral Velho, Catingueira, Salgadinho, Diamante, Imaculada, Tavares, Santana do Garrotes, Boa Ventura, Cajazeirinhas and Passagem (Figure 10).

The total spending in the water resources sub-function is the highest recorded among all function 18 sub-functions in Paraíba State, which totaled R$ 57.974.409. This number exceeded by more than R$ 10 million the combined value of the other sub-functions in the state. Ibiara municipality stands out for spending almost R$ 8 million; it was followed by Itaporanga, São José de Piranhas and Santana de Mangueira municiaites, which exceeded R$ 6 million investments in water resources. In total, 16 municipalities presented spending higher than R$ 1 million. Paraíba results reinforce the trend pointed out by Borinelli et al. (2017), according to whom, resources allocated to the Environmental Management function in the Northeastern region tend to be concentrated in the water supply function.

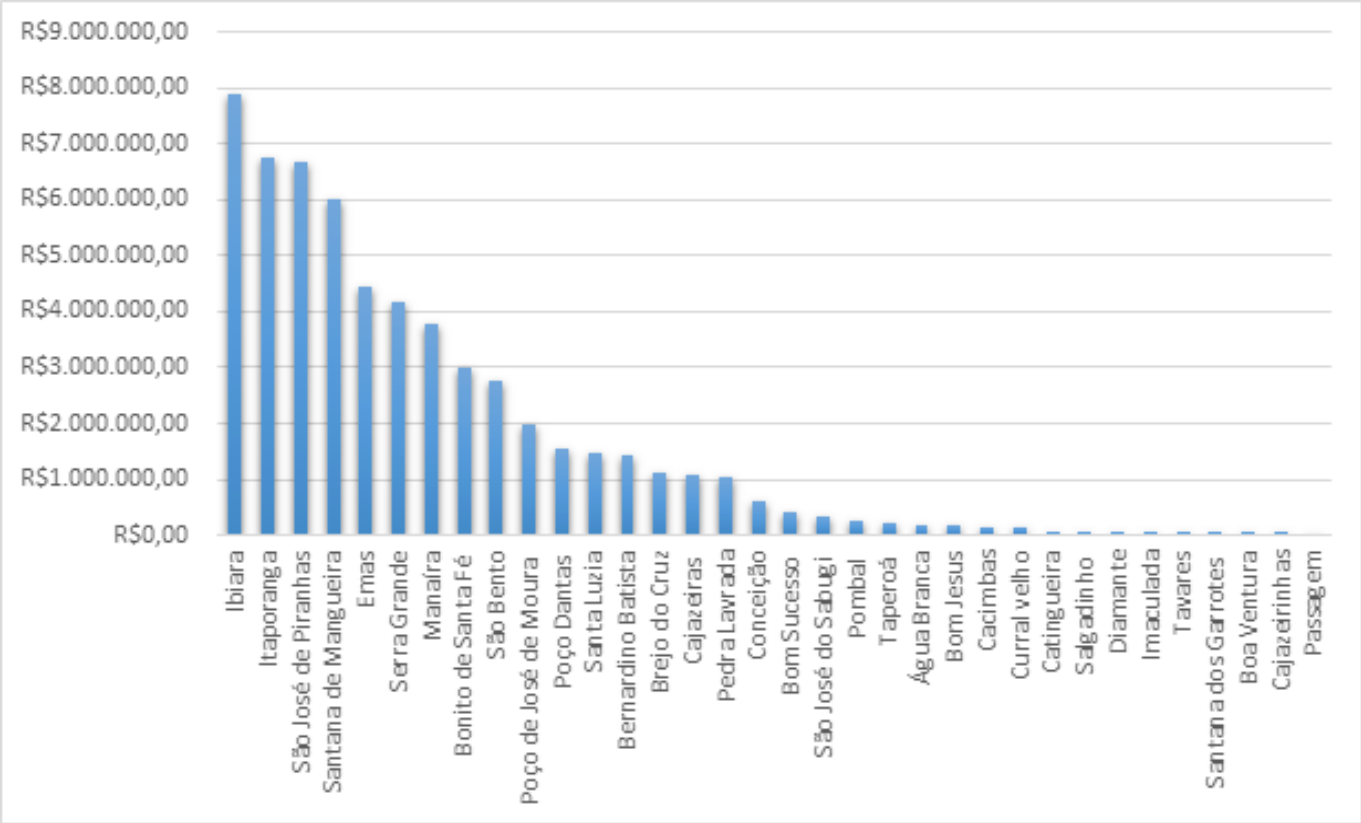


Figure 10

Description of the total spent by municipality in water resource areas in the Piancó-Piranhas-Açu River Basin, Paraíba State.

SOURCE: Adapted from the STN, 2023.

5. Final considerations

Despite limitations imposed on this analysis, which also takes into consideration the imprecision and lack of data-transfer standardization on expenditures on function 18 (Environmental Management) by the NTS (National Treasury Secretariat), the present article met its aim of exploring the topic to disclose problems linked to the implementation of environmental policies by municipalities forming the Piancó-Piranhas-Açu River Basin. Therefore, this issue proves to be of fundamental importance for building the favorable conditions to the region's sustainable development.

The results point out a worrisome scenario regarding the municipalities' current investment capacity and, consequently, their co-participation in environmental policies, if one bears in mind their constitutionally embodied duties and the possibilities emerging from their proximity to the territory. This scenario is worsened by the environmental and climatic conditions inherent to the region and by the high degree of dependence on natural resources exploitation as its main economic activities.

Therefore, it is possible stating the environmental spending asymmetry in the Basin's municipalities, which, as observed by Borinelli et al. (2017) and Pereira and Figueiredo Neto (2020), also takes place at state level and in municipalities with more than 100.000 inhabitants throughout the country. However, according to the results, the disparities tend to be deepened in the analyzed region, which shows outstanding participation by small municipalities, whose economic reality, in most cases, is linked to dependence on transfers and agreements with other governmental levels.

This process is made clear by the fact that 32% of municipalities did not register any environmental spending type, whatsoever.

Resources allocation, as observed through the analysis of sub-functions, was diverse, but it showed higher concentration in sub-functions 'preservation and conservation' and 'water resources'. Sub-function 'preservation and conservation' recorded the largest total in Rio Grande do Norte State, mainly in Alto do Rodrigues municipality, which spent more than all other municipalities in the state (more than R$ 18 million) together, alone. The water resources sub-function held the highest accumulated expenditure in Paraíba State (more than R$ 57 million). Paraíba State seems prone to invest more in environmental spending, as already shown in other studies. It seems to be willing to have its resources allocated to this sector, mainly to water resources. The State registered 61% expenditure on this sub-function. A very low resource allocation was recorded for the degraded areas sub-function. It was only observed in Rio Grande do Norte's Seridó region. The disparities in the total spent by each municipality suggest that the total of resources addresses specific issues inherent to different local economic, environmental and political scenarios, which require specific approaches to be disclosed.

Given the context emerging from the bibliographic and documentary contributions and from research results, further research addressing the herein presented topic, field and issues is recommended. Elements like municipalities' capacity to join SISNAMA (National Environmental System), their budget share, environmental spending fluctuation and heterogeneity need to be better understood. Likewise, the association between initiatives developed at municipal level and challenges posed by issues such as climate change, the rational use of water resources, desertification, siltation and the recovery of riparian forests and native vegetation is crucial.

The use of data based on other perspectives is necessary to make in-depth analyses and achieve results that are more representative of the reality in the Basin and to associate municipal territory and environmental spending. Considering specific areas and environmental problems can be a fruitful approach, as it can project results against other relevant data like population size, territorial extension and/or revenue. Furthermore, using data as parameter or indicator to be complemented by field analyses capable of disclosing the impacts of investments or of lack of it in environmental public policies implementation, *in situ*, are possibilities that should be considered.

Finally, the present results reinforce the findings in the research they are included in. It observed that municipalities in the Basin tend to have low adaptive capacity to climate change, given their incipient actions aimed at risk and disaster management (Santos & Pessoa, 2025; Andrade & Pessoa, 2025), in addition to the expectation for significant exposure to extreme droughts in the coming decades (Dias et al., 2023). This scenario

points out the need for the strategic inclusion of environmental issues on municipal governments' agendas, mainly due to the ongoing global climate crisis that deeply affects them.

Acknowledgements

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