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State capacities and payment for environmental services in Brazilian municipalities

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Abstract

Payments for Environmental Services (PES) aim to promote environmental conservation or recovery through economic incentives. However, the limited experiences with PES in developing countries demonstrate a gap between the theoretical framework and the actual implementation of the program. This study analyzes the relationship between administrative and political capacities and the existence of PES in Brazilian municipalities. The study presents results from empirical research, with data extracted from the Survey of Basic Municipal Information (MUNIC) carried out by the Brazilian Institute of Geography and Statistics (IBGE) in 2012, 2017, and 2020. The results show that municipal PES programs reach 15% of Brazilian municipalities in 2020. They also indicated a high rate of program dropout over time. The results of the empirical analysis, including descriptive statistics and probit regression, show that some technical-administrative competencies are associated with PES programs in the municipalities, including the qualifications of officials, the existence of an Integrated Solid Waste Management Plan, and the presence of environmental management bodies in the municipality. Political-relational competencies are also related to the existence of PES programs, including an active Municipal

Environmental Council. These results highlight that there is no one-size-fits-all solution for successfully implementing PES programs since they depend on specific circumstances, including local institutional capacities. This conclusion requires further attention and research in the environmental economics literature, which tends to present PES as a universal solution.

Keywords: Payments for Environmental Services, environmental policy, municipal administration, state capacities, Brazil

I. Introduction

Brazil is a Federative Republic with three layers of government: federal, 26 states and the Federal District, and 5,570 municipalities. These entities have political, administrative, fiscal, and legal autonomy and a series of competencies established in the Constitutional text.

According to the Federal Constitution (Brasil, 1988), the protection and preservation of the environment are competencies shared between the entities. This decentralization of responsibilities has required Brazilian municipalities to expand administrative and political capacity for environmental programs. Consequently, there has been an increase in demands for more professionalized municipal management and the need to establish mechanisms for democratic control and popular participation in government actions (GRIN et al., 2021).

Payments for environmental services (PES) are among the public policies developed by municipalities to fulfill their constitutional obligations in terms of environmental protection. These initiatives intend to stimulate voluntary environmental conservation or recovery actions through economic incentives. According to economic theory, PES solutions can create business possibilities in the private sector while meeting environmental objectives (Wunder, 2005). Therefore, academic institutions and national and multilateral organizations promote and advocate for this policy approach.

Nevertheless, there are a limited number of PES projects in developing countries, many of which are small-scale and short-lived. Also, there is little literature discussing the factors that contribute to the existence of a PES program in developing countries, and even fewer studies concerning the importance of governance and institutional capacities. This study aims to identify the

relationship between technical-administrative and political-relational capacities and the existence of payment for environmental services in Brazilian municipalities.

To this end, we began with a section on state capacities and their influence on public policies. The following sections consist of (iii) a description of payments for environmental services and their development in Brazil, (iv) the research methodology, and (v) the presentation and discussion of the results. The article concludes that empirical results in Brazil favor the hypothesis that municipal technical-administrative and political-relational capacities are relevant to payments for municipal environmental services.

II. State capacities

Discussing the state's capacities is complex, marked by different definitions and multi-dimensional approaches. The concept was developed in the 1960s to comprehend the state's role in development. However, Cingolani (2013) suggests that there still needs to be more consistency in the relationship between conceptual and subjective elements in research on state capacities. On the other hand, Stein (2015) argues that state capacities are a flexible concept that links different aspects of state action and its structures with society and the economic system.

The first studies emphasized technical-administrative skills in the functioning of the state. However, changes in society, mobilized by globalization, by the interdependence between state and non-state actors, in addition to the emergence of self-organized networks in the implementation of public policies, stimulated the expansion of this perspective. Thus, more recent studies on state capacities also valued the political-relational skills understood as necessary for the state to achieve its objectives (Pires & Gomide, 2016).

Lindvall and Teorell (2016) propose that a comprehensive theory of state capacity should explain how authorities utilize resources and which policy instruments are employed to control the population. Even if it is understood that the theory in question discusses the maintenance of order in a given territory and addresses the necessary skills and resources, there is no consensus in the literature regarding the specific definition of state capabilities (Akbar & Ostermann, 2015).

For the World Bank (1997), this concept deals with efficiently undertaking and promoting collective actions. Skocpol (1985) defines state capacities as the ability of the state to implement objectives even with the opposition of powerful social groups or in the face of difficult socioeconomic circumstances. Xun, Ramesh, and Howlett (2015) divide state capacity into individual, organizational, and systemic resources and capabilities combined with analytical, operational, and political skills and competencies. In this proposition, the authors recognize that different actors collaborate with the government in carrying out policies and that such capabilities and skills are necessary in all political processes. In municipal spheres, state capacity refers to the collection of administrative, political, technical, and institutional resources and skills that municipal governments have to achieve their objectives and overcome restrictions (Grin et al., 2021).

The concept of state capacities is multi-dimensional. Thus, Cingolani (2013) identified seven dimensions most frequently mentioned in the literature on state capacity:

- The coercive/military dimension is the state's ability to monopolize coercive power.
- The fiscal dimension refers to the state's capacity to collect taxes and use such resources.
- The administrative or implementation dimension is based on the existence of a professional and insulated bureaucracy.
- The transformative dimension deals with the state's ability to intervene in the production system and shape the economy.
- The relational dimension or territorial coverage seeks to capture the capillarity of the state and its connection with the different groups in society.
- Legal dimension, focusing on the role of the state in guaranteeing commitments and the execution of contracts.
- Political dimension refers to the power of elected leaders to induce priorities between different institutional actors (parties, Congresses, Chambers).

This list of dimensions related to state capacity is not exhaustive, and it is possible to find authors who propose other attributes to the concept. However,

Aguiar and Lima (2019) argue that three dimensions of capacity receive the most attention in different studies:

- The bureaucratic dimension related to human resources and their skills
- The relational dimension, which addresses aspects of interaction as a condition for the proper functioning of policies
- The political dimension of negotiation and consensus-building

This work is based on the proposal by Gomide and Pires (2018), who highlight the technical-administrative and political-relational dimensions of state capacity in democratic societies. The technical-administrative dimension of state capacity involves the ability to implement public policies. It deals with the existence of a professionalized and competent bureaucracy with the resources to coordinate strategies at different levels of government. The political-relational dimension is the ability to include multiple actors in the public policy process. It expands dialogue with civil society and actors in the political-representative system while allowing elected governments to enforce their priorities (Pires & Gomide, 2018). For the authors, state capacities are determined by the institutional arrangements of each society. These arrangements are the rules, mechanisms, and processes that define how actors and interests are coordinated (Gomide & Pires, 2014).

Many Brazilian studies have explored the relationship between state capacities and the performance of public policies. These studies show that professionalized organizations and coordination mechanisms (technical-administrative capacities) make public policies more effective. On the other hand, political-relational capacities, based on participation channels, generate innovation in public policies (Pires & Gomide, 2016). Other studies show that the autonomy of the secretariat responsible for the policy, combined with interaction with the different actors involved with the policy, generates better implementation (Segatto et al., 2021). Planning capacity is also used as a proxy for the administrative capacity of municipalities. In this case, it is argued that the weakness of municipal planning reflects low administrative capacity and, therefore, the plans' ineffectiveness (Lima et al., 2020). It is worth highlighting the study by Grin et al. (2018), which analyzed, using multivariate statistics, Brazilian municipalities' administrative, technical, political, and institutional capacities on their fiscal performance. This study found that the number of civil servants, their

training, and the existence of public policy councils and inter-municipal consortia explain the best results of municipal fiscal policy. It also found that control variables, such as population size and GDP per capita, impacted the best results.

These studies have in common the idea that building state capacities is necessary for governments to achieve their objectives. In other words, "the absence of certain capacities can impact the development of numerous policies and reduce the scope of government actions" (Grin et al., 2021, p. 44).

This paper does not aim to analyze the relationship between state capacity and public policy results but rather the relationship between technical-administrative and political-relational capacities with the existence of PES as a municipal public policy in Brazil. As a proxy for technical-administrative capacities, we considered human resources (availability and training), organizational development (administrative structures responsible for the policy), and budget resources related to the environment in each municipality. The existence of municipal environmental councils was used as a proxy for political-relational capacity. These are spaces for participation in which public authorities and civil society discuss and make decisions on public environmental policies on an equal footing.

Although not compulsory, these councils are present in most municipal public administrations to produce a more democratic environment for public management. Their duties include participating in planning state policies, budgetary control, approving public-private partnerships, and establishing procedures for the democratization of information and government decisions (Castro et al., 2019).

III. Payments for environmental services (PES) in Brazil

Ecosystem services are benefits generated by the environment for society. MEA (2005, p. V) groups them into four categories: direct provision of natural products, environmental regulation, cultural benefits, and support services. According to Brazilian legislation, ecosystem services are benefits humans derive from nature, while environmental services are individual or collective activities that favor ecosystem services' maintenance, recovery, or improvement (Brasil, 2021).

Many natural services are threatened despite their importance to human life and ecosystems. Payment for ecosystem services (PES) initiatives can help maintain these services and contribute to implementing environmental policies. They refer to economic incentives of various kinds granted to landowners or other "environmental protectors" to guarantee the preservation or recovery of the ecosystem. The main idea is that the beneficiaries of environmental services make direct payments, established through contracts, to the owners or users of the land in exchange for adopting practices that preserve or restore the ecosystem (Wunder, 2005).

At first, PES programs did not envisage public resources or funds, believing that the market would absorb this demand between producers and consumers of environmental services. However, the state has become involved in PES programs and projects as a regulatory and fiscal agent for the services traded or as the party responsible for promoting these projects since the market still needs to recognize environmental externalities (Fiori et al., 2020).

In Brazil, Law No. 14,119 (Brasil, 2021) was passed in 2021, establishing the National Policy for Payment for Environmental Services. After more than ten years of discussion in the National Congress, this Law established the definitions, payment modalities, management bodies, objectives, and guidelines for PES in the country. However, it left open issues such as the tax system and incentives for carrying out projects at a national level.

Despite the current legislation, there have so far been few PES initiatives stimulated by federal entities. The federal initiatives have been pilot projects with little long-term continuity. Most PES initiatives in Brazil are relatively small projects regulated by local authorities and promoted by state and municipal governments, usually in association with non-governmental organizations (Young & Castro, 2021). They have specific institutional arrangements, meeting the peculiarities and needs of each region, mainly characterized by small-scale dimensions and a lack of stable financial sources (Castro et al. 2018).

Castro et al. (2018), focusing on PES programs at the state level, showed that such initiatives depended mainly on public resources, with little incentive to implement user/polluter payment mechanisms compatible with current legislation. However, the public budget faces restrictions on fiscal resources,

especially those earmarked for environmental policy (Young et al., 2012; Young & Medeiros, 2018; Werneck et al., 2022).

Numerous studies have been conducted on municipal PES projects. Various sources indicate different numbers of PES projects in Brazil, which refers to countless initiatives on a local/ municipal level that represent new experiences throughout the country (Prado et al., 2019; Coelho et al., 2021). However, the information is dispersed and spread across different institutions, and the present article aims to contribute to systematizing information on PES in Brazil, making it easier to analyze.

While the concept of PES may appear straightforward, its implementation often poses various challenges and obstacles. These include limited demand due to the lack of voluntariness for these payments, lack of institutional prerequisites required for negotiations, difficulties in ensuring compliance with contracts and guarantees for poor and remote communities, and communication barriers between those proposing PES programs and local communities (Godecke; Hupffer; Chaves, 2014). Despite the difficulties, PES systems offer several advantages:

- They increase awareness regarding the value of natural resources;
- They facilitate conflict resolution and consensus building;
- They improve the efficiency of allocating natural, social, and economic resources;
- They generate new funding sources for conserving, restoring, and enhancing ecosystem services and natural resources;
- They create indicators of the importance of ecosystem services and natural resources;
- They transfer resources to economically vulnerable sectors (Godecke; Hupffer; Chaves, 2014; Garcia & Longo, 2019).

The successful implementation of PES systems depends on establishing local arrangements and partnerships based on stakeholders' mutual interests and stable payment sources (Young & Castro, 2021). Financial mechanisms for conserving biodiversity and ecosystem services must be flexible, combine different fundraising strategies, and adapt to each context. Furthermore, private participation does not diminish the importance of public environmental agencies,

which remain the central agents in environmental policy coordination, planning, and operation (Young & Castro, 2021).

IV. Methodology

The central hypothesis of the research is that technical-administrative and political-relational capacities are relevant to the existence of municipal PES in Brazil. For that, we carried out statistical analyses of data from various research and official information portals, mainly the Municipal Basic Information Survey (MUNIC), carried out annually by the IBGE (IBGE, 2018, 2021). MUNIC examines the characteristics of Brazil's 5,570 municipal administrations. It presents detailed information on municipal public management, including its structure, planning instruments, organization, personnel, and sectoral public policies in the areas surveyed (housing, transport, agriculture, environment, and others).

MUNIC included specific questions on PES in the 2012, 2017, and 2020 surveys. The three surveys define payment for environmental services as “monetary or non-monetary retribution for human activities to restore, recover, maintain, and improve ecosystems that generate environmental services supported by specific plans and programs” (IBGE, 2013, p. 185).

The surveys conducted by MUNIC only include PES initiatives where the municipality pays or receives funds for it, excluding those involving exclusively private or third-sector organizations. In these cases, the municipal government can pay directly, based on a specific budget allocation, or indirectly through a linked entity, such as the Municipal Environment Fund (IBGE, 2013).

However, the questionnaire conducted by MUNIC in 2012 has different questions and data than the ones for 2017 and 2020. Given the differences, we decided to compare the three results only on whether municipalities pay for environmental services and which services are paid. The answers are binary (the municipality has or does not have PES), and the volume of resources and the number of beneficiaries reached by PES are not measured.

The existing data allowed an econometric exercise consisting of a binomial regression analysis comparing municipalities' technical-administrative and political-relational variables in 2017 and 2020. The objective was to determine if PES programs (dependent variable) were associated with any of

these variables. We used the following independent variables as proxies of technical-administrative capacities:

1. The number of human resources working in the environmental field in the municipality;
2. The participation of the municipality's employees in training promoted by the federal government in the environmental area in the last four years;
3. The existence (or not) of an environmental management body in the municipality with its characterization;
4. The existence (or not) of an Integrated Solid Waste Management Plan under the National Solid Waste Policy terms;
5. Municipal expenditure on environmental management as a percentage of total municipal expenditure;
6. The existence (or not) of a Municipal Environmental Fund.

As a proxy for political-relational capacities, we use the following independent data for the specific discussion on state capacities:

1. The existence (or not) of a Municipal Environment Council;
2. The total number of meetings held by the Municipal Environment Council in the last 12 months.

The Brazilian Public Sector Accounting and Fiscal Information System (SICONFI) provided data on spending on environmental management as a percentage of total municipal expenditure. The exercise used the Environmental Management Function, which aggregates all municipal environmental spending (Ministério da economia, 2022).

IBGE provided geographical and demographic information, used as control variables: the municipality's population estimate, area, region of Brazil, and biome. Additionally, the amount of forest remnants (measured in Km²) was related to municipal environmental service payments, with data taken from MapBiomias.

It was also considered whether the municipality had experienced any extreme events in the four years before the survey on the existence of PES. Among the extreme events considered were droughts, floods, accelerated

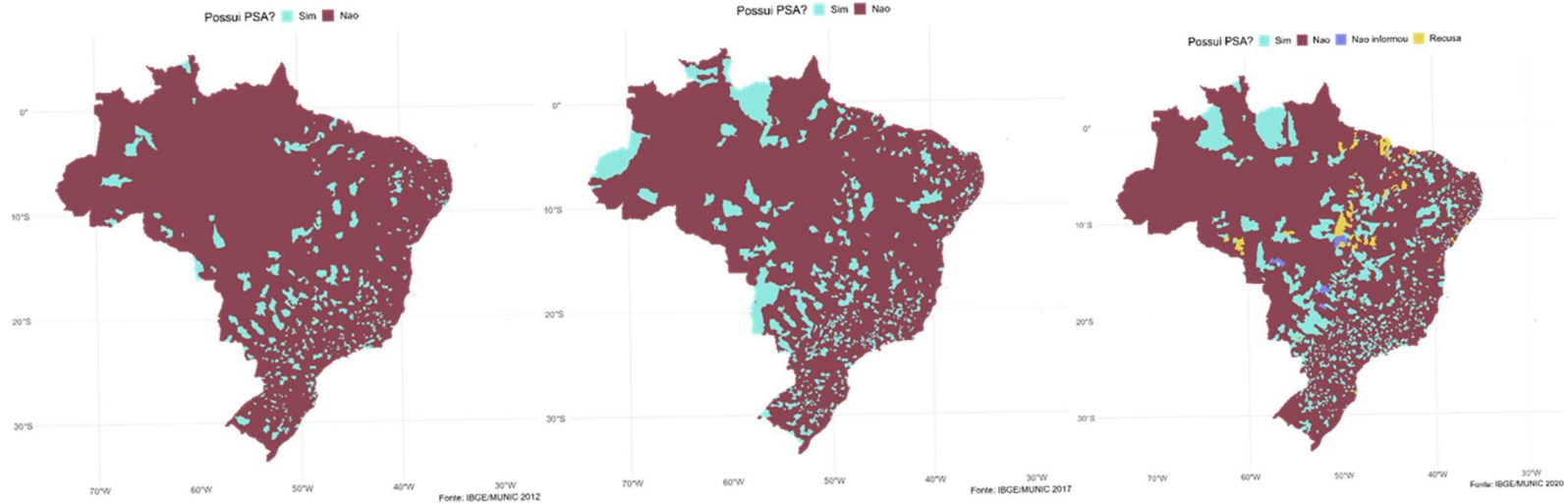
erosion, floods or gradual flooding, torrents or flash floods, and landslides or mudslides (IBGE, 2018, 2021).

However, MUNIC is based on self-reporting by the municipal governments. Usually, a civil servant is appointed by the local administration to organize the answers. Missing or incomplete answers (such as “Don’t Know”, “Declined” or “Not Informed” responses) are relatively common and generate noise in the data. In 2020, this problem was deeper due to the COVID-19 pandemic. Therefore, we excluded missing or incomplete answers. Table A in annex details the completeness of the data before exclusions.

V. Results

The results show a progressive increase in the number of PES at the municipal level, even though their number remains low in relative terms. In 2012, 418 municipal governments (7.5%) made payments for environmental services. In 2017, 643 municipalities (11.2% of the total) responded positively to the question; in 2020, the number rose to 837 (15.0%). Maps 1, 2, and 3 show the geographical location of the Brazilian municipalities that responded positively to the question.

Map 1 Municipalities with PES in 2012 Map 2 Municipalities with PES in 2017 Map 3 Municipalities with PES in 2020



Source: Own elaboration

*Only in 2020 the options "did not inform" and "refused to answer" were included in the available data, in addition to the options "yes" and "no" to the questions asked.

Maps 1, 2, and 3 show that there was an average increase of 41% in payment for environmental services initiatives between the years considered. At first glance, the increase in the number of municipalities with PES programs seems to reinforce the idea that the expansion of PES is a "natural" trend for local administrations.

However, the conclusions change when the municipality is identified. Of the municipalities that declared they had PES, only 35 kept the same answer over the three years. Between 2012 and 2017, only 88 remained with PES programs, and 203 municipalities declared that they had PES in 2017 and 2020. On the other hand, 90 municipalities claimed to have PES programs in 2012 and 2017 (Table 1).

Table 1 - Comparison of the number of Payments for Environmental Services initiatives among Brazilian municipalities, in 2012, 2017 and 2020

	2012	2017	2020
Total municipal PES	418	643	837
The same municipalities in 2012 and 2017	35	35	35
The same municipalities in 2012 and 2017	88	88	
The same municipalities in 2017 and 2020	-	203	203
The same municipalities in 2012 and 2020	90		90
Only in 2012	275	-	-
Only in 2017	-	387	-
Only in 2020	-	-	579

Source: Own elaboration.

The results indicate a high degree of policy discontinuity, and highlights the difficulty of maintaining municipal PES programs. The literature consistently points out the difficulty of PES persisting over time, mainly due to the lack of stable funding sources (Young & Castro, 2021). For example, Prado et al. (2019) analyzed water PES projects in Brazil between 2011 and 2014 and found that at least 50% of the projects active in 2011 were unsuccessful or no information was found in 2014.

When analyzing MUNIC data based on descriptive statistics, Castro et al. (2023) identified that municipalities with small populations and territories, less

environmental management capacity, and located in the Northeast or South tend to face more difficulties in maintaining PES. However, difficulties in implementation, continuity, and the importance of specific local and institutional characteristics are not usually considered when discussing PES programs.

In the present paper, we used a probit regression analysis to investigate whether certain variables related to state capacity literature are positively linked to PES projects in municipalities. We also examined the municipalities' geographic and demographic characteristics on the existence of PES projects in those areas. The results of this comparative analysis between 2017 and 2020 are presented in Table 2.

Table 2 - Regression (Probit model) analysis results

	<i>Dependent variable: existence of PES</i>	
	<i>2017</i>	<i>2020</i>
	<i>probit</i>	<i>probit</i>
Constant	-0.827***	-0.755***
	(0.202)	(0.189)
Population	0.00000	0.000
	(0.00000)	(0.00000)
Human resources in the environmental field	-0.0001	0.00000
	(0.0001)	(0.00001)
Municipal area (Km ²)	0.00000	-0.00000
	(0.00001)	(0.00000)
Spending on environmental management	-0.000	0.000
	(0.000)	(0.000)
The municipality has been hit by drought for the last four years	0.045	0.116**
	(0.059)	(0.051)
The municipality has been hit by flooding for the last four years	0.100	-0.073
	(0.072)	(0.069)
Municipality hit by accelerated erosion over the last four years	0.028	-0.023
	(0.062)	(0.055)
The municipality has been hit by floods or gradual flooding in the last four years	0.077	0.056
	(0.071)	(0.066)
The municipality has been hit by flash floods in the last four years	-0.075	0.052
	(0.067)	(0.061)
The municipality has been hit by landslides or mudslides in the last four years	0.032	-0.026

	(0.074)	(0.068)
Municipality officials took part in environmental training promoted by the federal government	0.226***	0.209***
	(0.050)	(0.046)
Municipal Environmental Council	0.043	0.043
	(0.076)	(0.076)
Number of meetings held by the Municipal Environment Council in the last 12 months	0.013**	0.028***
	(0.006)	(0.006)
The municipality has a Municipal Environmental Fund or similar	0.169**	0.069
	(0.061)	(0.057)
The municipality has an Integrated Solid Waste Management Plan	0.437***	0.193***
	(0.053)	(0.051)
Municipalities located in the Amazon Biome	-0.207*	-0.408***
	(0.130)	(0.129)
Municipalities located in the Caatinga Biome	0.027	-0.106
	(0.117)	(0.106)
Municipalities located in the Cerrado Biome	-0.109	0.007
	(0.077)	(0.070)
Municipalities located in the Atlantic Forest Biome	-0.068	-0.059
	(0.091)	(0.081)
Municipalities located in the Pampa Biome	0.293**	-0.102
	(0.127)	(0.125)
Municipalities located in the Pantanal Biome	-0.003	-0.113
	(0.334)	(0.381)
Total forest remnants in the municipality (km ²)	-0.000	-0.00000
	(0.00000)	(0.00000)
Municipalities located in the Northeast	-0.354***	-0.251**
	(0.143)	(0.139)
Municipalities located in the Southeast	-0.151	-0.219*
	(0.140)	(0.139)
Municipalities located in the South	-0.251*	-0.332***
	(0.152)	(0.149)
Municipalities located in the Central West Region	0.074	0.164
	(0.132)	(0.132)
The municipality has an environmental body	0.665***	0.534***
	(0.145)	(0.135)
The municipality has an environmental department under another secretariat	0.455**	0.668***
	(0.153)	(0.142)
The municipality has an environmental secretariat in conjunction with other sectoral policies	0.529***	0.463***
	(0.140)	(0.131)

The municipality has an environmental body under indirect administration	0.758**	0.722**
	(0.240)	(0.227)
The municipality has an environmental department reporting directly to the head of the executive branch	0.707***	0.398**
	(0.185)	(0.165)
Observations	4,791	4,679
Log Likelihood	-1,730.183	-2,091.655
Akaike Inf. Crit.	3,524.366	4,247.309
<i>Note:</i>	0 **** 0.001 *** 0.01 ** 0.05 * 0.1 ' ' 1	

Source: Own elaboration.

Table 2 shows that the technical-administrative capacity of the municipality contributes to the existence of PES programs in both years, corroborating the literature on state capacities. This literature points out that the provision and qualification of employees can increase government performance and the efficiency of public policies (Marenco, 2017). However, in the present case, the qualifications of the employees are more relevant to the implementation of PES than the number of municipal employees. The training provided to municipal officials by the federal government probably helped spread understanding of the issue, providing incentives to break down resistance to creating PES programs.

Another variable related to technical-administrative capacity that proved relevant to municipal PES is the presence of an Integrated Solid Waste Management Plan under the terms of the National Solid Waste Policy. As in other studies (Lima et al., 2020), planning capacity is related to the bureaucracy's ability to make diagnoses, establish priorities, and comply with legislation. This specific plan was used as a proxy due to its relationship with environmental management. Thus, it was found that there are more PES programs in municipalities with this plan.

The existence of a body responsible for managing the municipality's environment has a significant impact on the implementation of PES programs in 2017 and 2020. This is especially true when compared to municipalities that do not have such a body. Furthermore, these findings are consistent with other

studies (Segatto et al., 2021), which indicate that an independent secretariat has a greater ability to implement policies.

Among the factors that contributed to the existence of PES programs in only one year is the existence of a Municipal Environmental Fund, which was only relevant for the survey carried out in 2017. On the other hand, spending on environmental management was not relevant to the analysis, which may mean that this type of initiative is independent of how much the municipality spends on environmental management, as it can include public-private partnerships to pay for it.

This point is related to the discussion of PES funding. According to the IBGE (2013), the primary source of funding for payment for environmental services in the 12 months prior to the collection of MUNIC information for 2012 was the state government (75%), followed by the federal government (17%) and private initiative (17%), with more than one answer allowed. In the 2017 and 2020 surveys, the municipal budget appeared as the main source of PES funding for 82.7% and 83.2% of municipalities, respectively (IBGE 2018, 2021). These results draw attention to the change in the source of funds indicated by municipalities as responsible for financing PES. Furthermore, they are at odds with the statistical results, which found no relationship between spending on environmental management and the existence of municipal PES programs. The reasons for this are yet to be better investigated to contextualize them within the economic dynamics of each period surveyed.

Concerning the political-relational dimension of state capacities, the number of meetings held by the Municipal Environment Council in the last 12 months is important to the existence of the PES. The council itself did not appear as relevant, which is consistent with the idea that it is not enough to have the council; it needs to be functioning. This means that the more meetings held, the more likely the municipality will have projects to pay for environmental services. Other investigations on state capacities (Grin et al., 2018; Pires & Gomide, 2016) have also shown the importance of citizen participation as a proxy for the political-relational capacity to realize and innovate public policies.

Among the geographical and demographic factors, the Amazon Biome presented a negative but significant coefficient. This indicates that the number of PES in this biome is smaller than expected if compared to other biomes.

Regarding the regions, with the North Region of Brazil as a parameter, the Northeast Region and the South Region are less likely to have municipalities with PES projects.

The analysis considered different environmental disasters, as their occurrence can justify the existence of environmental policies. However, in this research, only the drought cases are significantly related to the existence of PES projects in 2020. In other words, the majority of climate disasters that were examined did not lead to the establishment of PES programs at the local level.

Regarding the environmental services considered in municipal PES projects in 2012, 2017, and 2020, Table 3 shows the distribution of responses. As more than one answer was allowed, the sum of the columns exceeds the number of municipalities with PES.

Table 3 - Municipalities with affirmative answers to the question about the existence of municipal Payment for Environmental Services programs and type of environmental service in 2012, 2017 and 2020

	2012	%	2017	%	2020	%
Existing PES in municipalities - Total	418	-	643	-	837	-
Environmental service(s) covered	-	-	-	-	-	-
Quantity and quality of water resources	161	22%	273	24%	324	21%
Native vegetation and wildlife	93	13%	176	15%	190	13%
Protected Areas and Indigenous Lands	53	7%	88	8%	101	7%
Soils and restoration of vegetation cover and degraded areas through agroforestry systems	115	16%	206	18%	217	14%
Remnants of vegetation in urban areas	115	16%	142	12%	216	14%
Carbon capture and retention	25	3%	37	3%	43	3%
Other	178	24%	219	19%	429	28%
Total mentions	740	100%	1141	100%	1520	100%

Source: own elaboration, based on IBGE (2013, 2018, 2021).

There is a wide dispersion of topics, but "quantity and quality of water resources" is the most voted environmental service (excluding the "other"

category). The categories referring to the occupation of the territory with native vegetation, such as protected areas, restoration of degraded areas, and remnants of vegetation in urban areas, also stand out. On the other hand, the low incidence of PES related to carbon capture and retention shows the low impact of climate change mitigation as a motivator for PES in Brazil.

VI. Final Considerations

This study aimed to identify the relationship between technical-administrative and political-relational capacities and the existence of payment for environmental services in Brazilian municipalities. To this end, we used data from the 5,570 Brazilian municipalities and their PES programs available in MUNIC for 2012, 2017, and 2020 (Brazil, 2013, 2018, 2021). We carried out a descriptive statistical analysis for the three years mentioned and conducted a probit regression analysis only for the years 2017 and 2020 due to discrepancies in the data collected over time.

The central hypothesis of the research was that technical-administrative and political-relational capacities are relevant to municipal PES in Brazil. Thus, we identified independent variables used in different national studies (Grin et al., 2018; Lima et al., 2020; Segatto et al., 2021) to identify these capacities in municipalities.

Our results revealed that some technical-administrative competencies were associated with PES programs in the municipalities. These competencies included the qualifications of officials, the existence of an Integrated Solid Waste Management Plan, and the presence of environmental management bodies in the municipality.

As for political-relational competencies, we found that municipalities that held more meetings of their Municipal Environmental Councils in the 12 months prior to the survey were more likely to have PES programs. This result suggests the importance of participation and the municipality's ability to deal with this participation in PES projects.

However, it is essential to note that, despite municipalities playing an important role in environmental policies, the adoption of PES programs remains low in Brazil, covering only 15% of municipalities in 2020. In addition, these initiatives often face challenges in maintaining their continuity over time.

According to specialized literature, the effective implementation of PES programs depends on creating local arrangements, solid partnerships, and stable funding sources that combine diverse resources. The public sector is recognized as a key actor in this context, responsible for coordinating, planning, monitoring, and, in some cases, operating environmental policies.

In this sense, there is still a need to strengthen municipal capacities if municipal PES programs are to gain scale in the country. It is not enough to launch PES programs; it is essential to prepare municipalities and other actors involved to participate in and manage these programs effectively.

Collaboration between the federative spheres is fundamental to strengthening municipal policy implementation capacities. This cooperation must be based on partnerships, financial resources, technical assistance, and training, ensuring that municipalities can meet the needs of their communities efficiently and effectively.

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Annex A

Table 1 – Data Completeness

Name	NA 2017	Completeness 2017	NA 2020	Completeness 2020
Payments for Environmental Services	0	100 %	106	98,10%
Population	0	100 %	0	100 %
Municipal area (Km ²)	0	100 %	0	100 %
Spending on environmental management	0	100 %	0	100 %
Human resources in the environmental field	16	99,71%	119	97,86%
Municipality officials took part in environmental training promoted by the federal government	2	99,96%		
The municipality has a Municipal Environmental Fund or similar	0	100 %	103	98,15%
Number of meetings held by the Municipal Environment Council in the last 12 months	193	96,54%	0	100 %
The municipality has an Integrated Solid Waste Management Plan	0	100 %	108	98,06%
The municipality has been hit by drought for the last four years	138	97,52%	0	100 %
The municipality has been hit by flooding for the last four years	79	98,58%	284	94,90%
Municipality hit by accelerated erosion over the last four years	284	94,90%	172	96,91%
The municipality has been hit by floods or gradual flooding in the last four years	111	98,01%	439	92,12%
The municipality has been hit by flash floods in the last four years	125	97,76%	232	95,83%
The municipality has been hit by landslides or mudslides in the last four years	172	96,91%	286	94,87%
Municipalities located in the Northeast	0	100 %	270	95,15%
Municipalities located in the Southeast	0	100 %	0	100 %
Municipalities located in the South	0	100 %	0	100 %
Municipalities located in the Central West Region	0	100 %	0	100 %
Municipalities located in the North (Excluded)	0	100 %	0	100 %
The municipality has an environmental department under another secretariat	0	100 %	102	98,17%
The municipality has an environmental secretariat in conjunction with other sectoral policies	0	100 %	102	98,17%
The municipality has an environmental body under indirect administration	0	100 %	102	98,17%
The municipality has an environmental department reporting directly to the head of the executive branch	0	100 %	102	98,17%
The municipality has no environmental department (Excluded)	0	100 %	102	98,17%
Municipal Environmental Council	1	99,98%	0	100 %

Municipalities located in the Amazon Biome	0	100 %	0	100 %
Municipalities located in the Caatinga Biome	0	100 %	0	100 %
Municipalities located in the Cerrado Biome	0	100 %	0	100 %
	0	100 %		
Municipalities located in the Atlantic Forest Biome			0	100 %
Municipalities located in the Pampa Biome	0	100 %	0	100 %
Municipalities located in the Pantanal Biome	0	100 %	0	100 %
Total forest remnants in the municipality (km ²)	0	100 %	0	100 %

Source: Own elaboration.