



Brazilian National Waste Policy: perspectives after a decade of its enactment

Política Nacional de Resíduos Sólidos: perspectivas após um decênio de sua promulgação

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ABSTRACT: This article aims to analyze the implementation of the National Solid Waste Policy (PNRS) considering the instruments related to (i) solid waste plans, (ii) the National Solid Waste Management Information System (SINIR), and (iii) the goal of the environmentally adequate final disposal. The methodology used was document analysis. The results of the lack of a National Plan, partial existence of the State Plans (67%) and Municipal Plans (52%), shortcomings in SINIR and the existence of garbage dumps in 47% of Brazilian municipalities, showed that the advances in the axes of analysis are timid, denoting the inconsistency of planning with the implementation of the policy, the ineffectiveness of the PNRS in central aspects, and the need to review the federal government's action regarding the conduct of the PNRS and compliance with these criteria.

Keywords: national solid waste policy; solid waste plans; national solid waste management information system; final waste disposal; public policy.

RESUMO: O presente artigo objetiva analisar a efetivação da Política Nacional de Resíduos Sólidos (PNRS) considerando os instrumentos relativos aos (i) planos de resíduos sólidos, ao (ii) Sistema Nacional de Informações sobre a Gestão dos Resíduos Sólidos (SINIR), e à (iii) meta de disposição final ambientalmente adequada. A metodologia utilizada foi a análise documental. Os resultados de inexistência de Plano Nacional, existência parcial de Planos Estaduais (67%) e Municipais (52%), carências no SINIR e existência de lixões em 47% dos municípios brasileiros, demonstraram que os avanços nos eixos de análise são tímidos, denotando a

inconsistência do planejamento com a implementação da política, a inefetividade da PNRS em aspectos centrais e a necessidade de revisão da atuação do governo federal quanto à condução da PNRS e atendimento desses critérios.

Palavras-chave: política nacional de resíduos sólidos; planos de resíduos sólidos; sistema nacional de informações sobre a gestão dos resíduos sólidos; disposição final de rejeitos; políticas públicas.

1. Introduction

Solid waste generation is an intrinsic part of human activities and is linked to social processes, such as stimuli for consumption and the accelerated disposal of all sorts of products (Mavropoulos et al., 2015; Inoue & Ribeiro, 2016). The challenges of solid waste management in the 21st century range from the complexity and costs of the processes (collection, treatment, destination, among others), the increase in quantities, volumes and hazardoussness of solid waste generated in the country, as well as the final disposal 'solutions' used by many municipalities.

In Brazil, solid waste management is considered a component of basic sanitation, and up until 2010 it was the target of few investments, at the expense of the components 'water supply' and 'sanitary sewage', which are historically the government's priorities (Araújo, 2013).

In the period before 2010, there were pulverized regulations on solid waste, mostly represented by resolutions of the National Environment Council (CONAMA), often with implementation difficulties (Araújo, 2013; Godoy, 2013; Marotti, 2018).

In this context, the gap generated by the absence of specific national regulation for solid waste until 2010 contributed to the little attention received by the sector, particularly considering its complex characteristics. In addition, a heterogeneous reality

is observed throughout the country, with distinct deficiencies and disparities in the sector (Araújo, 2013; Godoy, 2013).

Besides less attention received, the absence of a national policy for solid waste with national, state and municipal guidelines, objectives and targets led to the omission of responsibility of public and private entities on the final disposal, recycling and reuse of waste, as well as the disarticulation of actions, resulting in isolation and consequent heterogeneity in public management in the sector (Siqueira, 2012; Godoy, 2013).

In this context, Law No. 12,305/10, which establishes the National Solid Waste Policy (PNRS), was enacted in August 2010 and is considered a fundamental regulatory framework for solid waste management, establishing a set of principles, objectives and instruments for the effectiveness of this management in the national territory.

Thus, the PNRS becomes a reference for the federated entities, by establishing general provisions and minimum requirements to be met throughout the country, unifying the main provisions for solid waste management that were previously scattered (Yoshida, 2012; Godoy, 2013).

Considering that solid waste management is a key issue for global sustainability, being associated in an interdisciplinary way with the areas of health, environment, and urban management, it is essential to address it, especially in a context of constant increase in waste generation. Taking the Brazilian

case as an example, the generation went from 62.78 in 2018 to 65.11 million tons per year in 2019, an increase of 3.71% (SNIS, 2018-2019¹).

From the point of view of social participation and control, the 1988 Constitution is a landmark and subsequent legislation comprises the need for integration of a wider range of actors, involving from the various spheres of the public sector - federal, state, and municipal - through private initiative, to civil society, either organized or from the individualized perspective of citizens (Silvestre, 2019).

The PNRS even seeks greater social participation, encouraging internal articulation between the spheres of government and external articulation with the private sector, as well as an articulation with civil society through organizations, committees, consultations and hearings, as well as other formats of public spaces.

In this scenario of increased generation and complexity of solid waste and the need for participation and social control, the policies that regulate this theme gain prominence. Especially the PNRS, which is considered the legal framework of the area and allows the linkage and the promotion of other policies and regulations in other federal entities (Ribeiro, 2012).

The public policy process is usually described as a five-stage cycle, namely:

- (i) agenda formation;
- (ii) policy formulation or conception;
- (iii) decision making;
- (iv) implementation; and

(v) policy evaluation.

The public policy cycle is a scheme for "visualization and interpretation that organizes the life of a public policy into sequential and interdependent phases" (Secchi, 2012, p. 33), even if this understanding corresponds to a simplified picture of the complex public policy process (Jann & Wegrich, 2007).

In this sense, this article seeks to build an analysis of the PNRS ten years after its enactment, through:

- (i) the solid waste plans,
- (ii) the National System of Information on Solid Waste Management (SINIR) and
- (iii) the goal related to the environmentally adequate final disposal of waste.

To this effect, the stages of the cycle of public policies focused on in this article are:

- (a) formulation;
- (b) implementation; and
- (c) evaluation of public policies.

It is relevant to point out that Law No. 12.305/2010 is the result not only of technical understandings, but also of the power disputes of various social actors and different interest groups involved in the construction of this legislation (Santiago, 2021).

¹ The 2018 edition of the Diagnostic of Urban Solid Waste Management of the National Sanitation Information System (SNIS) had the participation of 3,468 Brazilian municipalities, representing 85.6% of the country's inhabitants. Whereas the 2019 edition had the participation of 3,712 municipalities, which corresponds to 86.6% of the Brazilian population (SNIS, 2018-2019).

Research oriented to the evaluation of public policies seek to identify and collect data, then analyze, interpret and inform about the actions, progress and effectiveness of the scope of study, providing feedback on the process. In this way, the results can help the progress of the public policy by showing its potential and weaknesses, areas that need more attention and resources, aspects that require revision and reformulation, issues that need optimization, and even the accountability of the policy (Costa & Castanhar, 2003; Rossi *et al.*, 2004; Ramos & Schabbach, 2012).

To reflect on the effectiveness of the PNRS, more than a decade after its enactment, is to understand how the implementation of objectives and goals set forth in the law have been pursued and achieved. The question is whether the actions developed and the resources employed - within the scope of this article - have been compatible with the desired benefits and, more widely, with the improvement of Brazilian socio-environmental conditions.

The time frame selected for analysis in this article covers a formative or monitoring evaluation (in itinere) - which is a type of evaluation that occurs in the process of implementing a public policy with the purpose of adjusting and redirecting programs, plans, and actions (Secchi, 2012) - from:

- (i) the multiscale planning in the PNRS;
- (ii) data availability, transparency and accountability; and
- (iii) the closure of landfills, a throbbing challenge for the sector.

Due to the unavailability of a systematized and consolidated database on the results of the PNRS implementation, it was necessary to develop

clippings, considering the existence and availability of data, to perform the analysis undertaken in this article.

1.1. Solid Waste Management and coping strategies

The generation of solid waste is an inherent practice to human activities. However, from (a) the Industrial Revolution, (b) the use of new materials - of difficult degradation in the environment -, (c) the use of toxic substances in production processes and (d) the decrease of product durability, solid waste generation becomes seen as a global environmental problem, notably after World War II (Mauch, 2016).

Throughout time, solid waste management has experienced structural changes, highlighting - in Brazil - the incorporation of the nomenclature 'solid waste' instead of 'trash', relinquishing a negative social representation of something worthless for a perception of value and possibility of generating employment and income (Kinnaman & Fullerton, 1999; Velloso, 2008).

However, the evolution of the approach to the theme occurred unevenly, especially between the higher and lower income countries, since the first group began to develop public policies aimed at addressing this issue around the 1970s. At that time, the focus of countries such as the then members of the European Union and the United States was centered on the eradication of inadequate final disposal sites, also known as dumps (Demajorovic, 1995; Louis, 2004; European Commission, 2010).

Starting in the 1980s, still in this same group of countries, the beginning of the recycling industry can be observed, in an attempt to reintegrate solid

waste into production processes, overcoming the linear paradigm about the useful life of recyclable materials. The first manifestations are also observed regarding the need to reduce waste generation, although it was only in the late 1980s that these countries - especially the members of the European Union - began to guide their policies on the logic of the order of priority for waste management, which begins in the non-generation and ends in the environmentally appropriate final disposal, in order to minimize the demand for raw materials and, at the same time, reduce the volume to be disposed of (Demajorovic, 1995; European Commission, 2010; Minelgaitė & Liobikienė, 2019).

In lower-income countries, particularly those belonging to Latin America and the Caribbean, it is observed that the previously mentioned phases have occurred and occur in an overlapping way, with no

conclusion of the dumpsite closure process to date, for example, even though there are already public policies guided by the logic of the order of priority - as it is the case of PNRS in Brazil - and of the circular economy. It is estimated that, in this region of the world, approximately 27% of the waste generated is still inadequately destined and disposed of (UNEP, 2018; UNEP, 2021). Figure 1 schematically presents this panorama, highlighting the posture of the countries in solid waste management. Proactive postures are those that sought to address solid waste management issues earlier; reactive postures, on the other hand, are those that sought to address them later, when solid waste management had already presented several socio-environmental and economic impacts to these countries for decades.

In the global picture, middle and low-income countries are where the growth rate of waste gene-

	First Policies	Waste Management Approach	Main Challenges
<u>United States</u>	(1965)	(Proactive)	(Hazardous Waste Management)
<u>European Union</u>	(1975)	(Proactive)	(Reduction in Generation)
<u>Latin America and the Caribbean</u>	(After 2000)	(Reactive)	(Policy Effectiveness)
<u>Brazil</u>	(2010)	(Reactive)	(Policy Effectiveness)

FIGURE 1 - Development of Public Policies aimed at solid waste management.

SOURCE: Adapted from Santiago (2016).

ration is the highest, especially in Africa and Asia. Furthermore, an estimated 33% of globally generated waste is destined or disposed of inappropriately, while recycling can range from 19% - on the global average - to more than 33% in high-income countries (World Bank, 2018).

This global panorama denotes that there is still much to be developed in the field of solid waste management, especially concerning low- and middle-income countries - such as Brazil. UNEP (2018) even considers that solid waste management is one of the biggest challenges for sustainability in Latin America and the Caribbean region.

2. Methodology

Aiming to carry out a formative evaluation of the National Solid Waste Policy, the methodological steps developed were carried out in four phases (Figure 1).

Phase 1 - Selection of the analysis axes

To establish the instituted axes to be analyzed in the implementation phase of the PNRS, it was considered: the relevance attributed in the PNRS to the planning instruments (national, state and municipal plans), presenting them as the main ways to outline the Brazilian solid waste management strategy; the necessity of having reliable official data for adequate planning; and the socio-environmental relevance regarding this public policy, in the case of the goal of art. 54 (Brasil, 2010a; Jacobi & Besen, 2011; Crespo & Costa, 2012). In addition to these aspects, the existence of deadlines for fulfillment was also considered, enabling an analysis of the

implementation of the instituted items according to the stipulated deadline.

Thus, three axes of analysis were defined: two of them are PNRS instruments (art. 8), (i) "I - the solid waste plans" and (ii) "XI - the National Solid Waste Management Information System (SINIR)"; as well as (iii) the goal of implementing the "environmentally adequate final disposal of waste", contained in art. 54.

Phase 2 - Bibliographic and documental research

Once the three axes of analysis were defined, the next step was bibliographic and documental research. The bibliographic research refers to materials already prepared (Gil, 2008), consisting of a fundamental stage towards greater familiarity with the theme and understanding of how the scientific community approaches it. Documentary research, on the other hand, is characterized by the use of documents without prior scientific treatment (Sá-silva et al., 2009), among these, those of legal nature, which are rich and stable sources of data (Gil, 2008).

The study of the first axis was conducted as part of the analysis of the Waste Plans in the federative spheres, namely: national, state and municipal, observing their current situation and the interdependence of these instruments.

The second axis was analyzed based on what is foreseen for SINIR in the Decree No. 7.404/2010, which regulates the PNRS, in "Title VIII - The National Solid Waste Management Information System - SINIR".

Finally, the analysis of the third axis, the goal for the final disposal, was done regarding the

fulfillment of the foreseen goals and its relation to the planning instruments for the implementation of the PNRS.

Phase 3 - Systematization of data and analysis of the current scenario

The lack of systematization and updating of data on the solid waste sector are weaknesses that hamper the advances in research on the theme, the implementation of PNRS and the guidance for decision making (Braga & Ramos, 2006; Figueiredo, 2011; Franceschi et al., 2017).

After researching and compiling the available information concerning the study axes, an analysis was performed as of the preparation of informative tables and graphs that summarize and correlate the information obtained.

Phase 4 - Analysis of PNRS compliance

Finally, aiming at joint analysis of the results and to synthesize them in conclusion, a Synthesis Chart (Figure 2) was created to summarize the situation of each axis in relation to its effectiveness.

3. Results and discussion

In this section, results are presented focusing on the analysis of the effectiveness of national, state and municipal solid waste plans, SINIR and the goal of environmentally adequate final disposal. The context and a brief history of the actions and decisions related to these themes are described, as well as the *status quo* of these topics contained in the policy, in addition to discussions that contextualize and corroborate to conclude on the general effectiveness of the PNRS at present.

3.1 Solid Waste Plans

Solid waste plans may be considered one of the main instruments of the PNRS, since they integrate several principles and instruments of the policy, particularizing them according to the distinct Brazilian realities. Besides integration, the plans provide possible scenarios for waste management, as well as the other stages of planning - favoring the participation of different actors in the process, such as civil society and large waste generators (Góes, 2011; Crespo & Costa, 2012).

The existence of planning tools, such as the Solid Waste Plans, helps managers in the decision-making process regarding the sector, promoting a proactive management, which makes decisions based on technical information. Thus, the planning

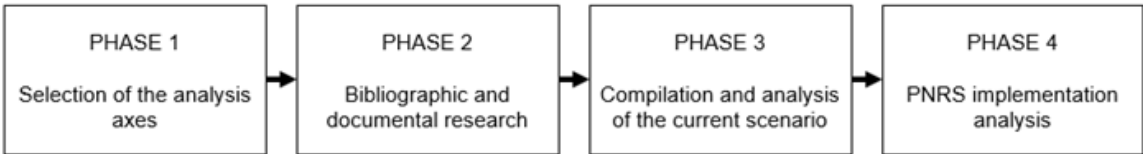


FIGURE 2 - Methodological flowchart of the study.

SOURCE: elaborated by the authors.

contributes for the public administration to have benchmarks to deal with different scenarios, while maintaining the desired direction for the sector, observing the technical and political feasibility of the actions and goals set, thus ensuring the improvement of the quality of life of the population and the environment (Crespo & Costa, 2012; Lisboa *et al.*, 2013).

Since the integrated management of solid waste is one of the main pillars of the PNRS, it determines that planning must be conducted at different levels - local, regional and national (Santiago, 2016). From this perspective, the plans are instituted in accordance with the federative entities and the corresponding management units. This is essential to ensure participation of all entities of the federation in the planning of solid waste management, providing elements that aim to institute general rules in the national sphere, subsidizing the planning of the states, and especially the municipalities - which, from their singularities, can propose and plan local actions aimed at improving the solid waste management system.

In this regard, it is important to highlight the concept of chaining or tiering, which addresses the orderly transfer of information between the planning levels (Arts *et al.*, 2011). Under tiering, even though there are different spheres of planning, there is alignment and coherence among them. Thus, the PNRS establishes the integration of management and collaboration among the federative entities, and not the hierarchization of planning (Jacobi & Besen, 2011; Crespo & Costa, 2012).

The plans established by the PNRS in Article 14 are: the National Solid Waste Plan (PLANARES); the State Solid Waste Plans (PERS); the Solid Waste Micro Regional Plans and the Solid Waste

Plans of Metropolitan Regions or Urban Agglomerations; the Intermunicipal Solid Waste Plans; the Municipal Plans for the Integrated Management of Solid Waste (PMGIRS); and the Solid Waste Management Plans (PGRS).

On this aspect, it is worth mentioning Article 55 of the PNRS, which establishes a deadline of two years for the State and Municipal Solid Waste Plans to become a requirement for the access to federal resources by these actors. Thus, the three main PNRS plans are presented and discussed below:

- (i) the PLANARES;
- (ii) the PERS; and
- (iii) the PMGIRS.

3.1.1 National Solid Waste Plan - PLANARES

The PNRS established the PLANARES as the national document of reference for solid waste planning. Its minimal content is listed in art. 15, including: diagnosis of the sector; scenarios considering international and macroeconomic trends; proposal of goals and programs to meet them; establishment of rules for access to federal resources for the sector; proposals to encourage and enable regionalization; guidelines for specific situations and for the environmentally adequate final disposal; and national control and inspection methods, considering social control (Brasil, 2010a).

With a 20-year planning timeframe and the obligation of updating it every 4 years, the procedures for producing the PLANARES were detailed in Decree No. 7.404/2010 in articles 46 and 47, with a deadline for submission of preliminary studies within 180 days from the date of publication of the

decree (12/23/2010), followed by 60 days of public consultation with at least one public hearing in each geographic region and a national public hearing (Brasil, 2010b).

Once the contributions from the public hearings were incorporated, the PLANARES would be presented for examination by the National Councils of the Environment, Cities, Water Resources, Health, and Agricultural Policy. With the approval of the PLANARES in all these spaces, the Minister of the Environment would forward it to the President of the Republic with the proposal for a decree approving the plan.

The studies to support the PLANARES began in 2011, soon after the enactment of Decree 7.404/2010, under the coordination of the Institute for Applied Economic Research (IPEA). This national planning effort aimed to identify the weaknesses in the management of the various typologies of solid waste, pointing out the possible management alternatives, in addition to the indication of goals, programs and actions towards the improvement of the current situation, observing the minimal content provided in the art. 15 of PNRS (Brasil, 2012; Brasil, 2010b). It is important to mention that PLANARES did not seek to address regional differences, which would be essential to identify the distinct realities and outline different regional approaches for planning in solid waste, allowing linkages throughout the state and municipal spheres (Malvestio *et al.*, 2012).

Figure 3 allows us to analyze the progress of the process of elaboration, approval, and publication of the PLANARES.

According to Figure 3, after the preparation of its preliminary version, six public hearings were held in each region of the country: South, in Curi-

tiba (PR); Northeast, in Recife (PE); Midwest, in Campo Grande (MS); Southeast, in Belo Horizonte (MG); North, in Belém (PA); and a national one, in Brasília (DF). From the contributions received, 190 were incorporated into the PLANARES and 318 were discarded. The outcome was a document with 29 guidelines, 170 strategies, and 28 goals to be approved by the Councils for subsequent publication (Brasil, 2012).

However, the process of approval of the PLANARES was not concluded. The document was still pending examination by the National Council for Agricultural Policy. In this regard, the General Comptroller's Office (CGU), in an Annual Audit Report on the Executive Secretariat of the Ministry of the Environment, states that:

"the absence of the publication of the National Plan makes it impossible to charge and monitor the results obtained regarding the goals and guidelines established in that document. Moreover, it undermines the consonance and conformity of that standard with that of the other State and Municipal Plans" (Brasil, 2019a, p. 12).

In a baseline report by the Federal Audit Court (TCU), with a survey conducted by the External Control Secretariat of Agriculture and Environment (Secex Ambiental), the absence of the National Solid Waste Plan is seen as an element that

causes a disincentive for States and Municipalities to elaborate their waste plans, since there is a lack of national guidelines and strategies on which the federative entities can orient themselves. Moreover, the lack of a document of this nature causes discredit in relation to the PNRS, since if the federal government does not have an approved and updated plan, its legitimacy to require States and Municipalities to prepare their own plans is questioned, especially in the case

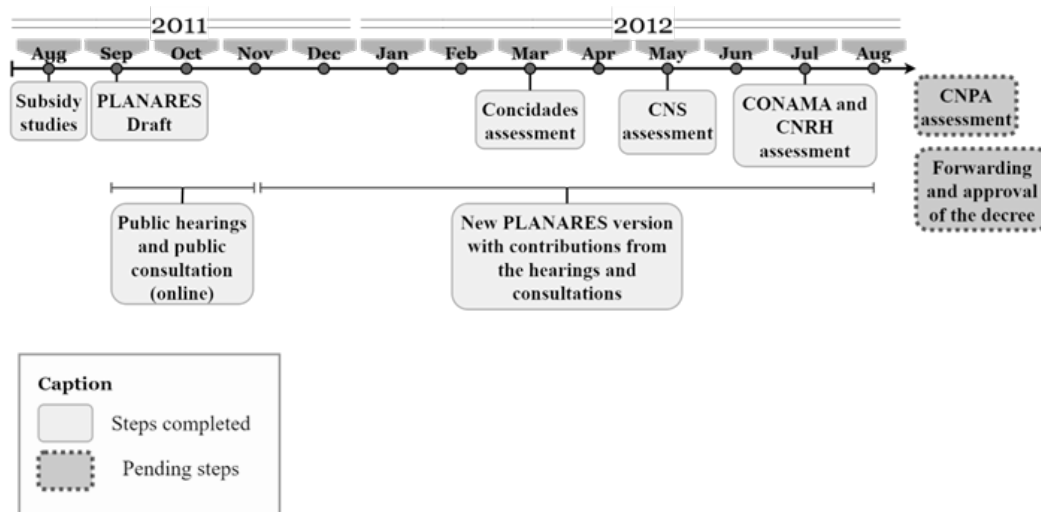


FIGURE 3 - Timeline of the elaboration process of the National Solid Waste Plan. Concidades - National Council of Cities; CNS - National Health Council; CONAMA - National Environment Council; CNRH - National Water Resources Council; CNPA - National Agricultural Policy Council. SOURCE: Prepared by the authors based on Pertussatti, 2018; Santiago, 2021.

of Municipalities with human resources deficiencies and less financial, technical, and operational capacity (Brasil, 2016, p. 5).

In TCU Judgment no. 2512/2016, dated 9/28/2016, the Ministers of the Federal Audit Court determined

to the Ministry of Environment and the Ministry of Agriculture, Livestock and Supply to forward to the TCU, within ninety (90) days, the due joint action plan for the updating and approval of the National Solid Waste Plan, with the definition of deadlines, activities and responsible parties, in order to meet the provisions of art. 46 of Decree No. 7,404, of December 23, 2010 (Brasil, 2016, p. 16).

Analyzing the panorama of solid waste management in the country presented in the 2012 version

of the PLANARES, the use of secondary data made explicit the deficiency regarding the existence of data and their updating, since the year of reference used by the diagnosis is 2008, which refers to the last National Survey on Basic Sanitation prepared by the Brazilian Institute of Geography and Statistics (IBGE). The Plan document highlights that this deficiency indicates the need for more comprehensive information, more reliable data, more surveys, shorter time intervals, as well as additional specific studies (Brasil, 2012).

A single scenario was adopted in the PLANARES prognostic stage, in line with the one adopted in the National Basic Sanitation Plan (PLANSAB) according to the following aspects:

- (i) macroeconomic policy;
- (ii) role of the State;

(iii) management, administration, stability and continuity of public policies/participation and social control; and

(iv) technological matrix/availability of water resources (Brasil, 2012; Brasil, 2014).

Concerning this single projection, it is worth noting the fragility of adopting a single scenario with an optimistic bias, without considering possible variations due to distinct population growth, economic and political instability factors, among others. Usually, sectorial plans adopt at least three scenarios with optimistic, realistic and pessimistic biases, so that the planning actions are feasible and foresee possible budget variations, waste generation variability, among other issues. In the case of the 2012 version of the PLANARES, the optimistic scenario addressed remained very distant from the country's current situation.

Furthermore, the social participation that took place in 2011 can be questioned - even though it meets the legal requirement - considering the number of hearings held given the continentality of the country and the cross-cutting nature of solid waste management, as well as the change in the national scenario in both general and solid waste terms between 2011 and 2020.

The Ministry of Environment (MMA) entered into a Technical Cooperation agreement with the Brazilian Association of Public Cleaning and Special Waste Companies (ABRELPE), free of charge, for the formulation of the following stages of PLANARES: "(i) the proposition of scenarios; (ii) the proposition of goals and monitoring indicators; (iii) the guidelines, strategies and financial resources to achieve the goals, and (iv) the programs, projects and actions to meet the goals" (Brasil, 2019a, p. 13).

It is noteworthy that there is a conflict of interest of ABRELPE as a formulator of PLANARES, since its goals, guidelines and strategies are directly related to the performance of the companies that are members of this association.

Considering TCU's Judgment no. 2512/2016 and the agreement signed between MMA and ABRELPE, there are also questions regarding:

- (i) how the diagnosis will be updated; and
- (ii) renewal of social participation in the PLANARES (re)elaboration process, considering the nine years that have passed since the public hearings and the changes contained in the new planning document, given that Brazil's reality is very different from that of 2011, notably in relation to the resources available for the implementation of the PNRS.

The updated version of PLANARES, elaborated by the MMA in collaboration with ABRELPE, was submitted to public consultation in 2020, with a process of virtual and face-to-face consultation, following the same logic as the previous version. However, until the first half of 2021, there was no update of the publicly available text considering the contributions that came from the social participation process. Furthermore, it should be noted that the use of secondary data was maintained, with little evolution in relation to the 2012 document.

The centrality of the planning process in the PNRS and the necessary linkage of the waste plans of the different territories have their greatest weakness in the absence of approval of the PLANARES. This absence results in the ineffectiveness of planning and goals set by the Federal Government, which reduces the sources of funding for federal

programs to stimulate solid waste management actions and, at the same time, intensifies the disarticulation of federal policies aligned with the principles and objectives of the PNRS.

3.1.2. State and District Solid Waste Plans - PERS

PERS is an instrument instituted by the PNRS under the responsibility of each state. The existence of the PERS is a condition for states to access resources under the domain or control of the Federal Government that aim to increase the management of solid waste in the federative unit. The minimal content required for the development of PERS is described in art. 17 of the PNRS, including: diagnosis of the current situation; elaboration of scenarios for planning; establishment of goals, programs, projects and actions; definition of technical standards; criteria for encouraging shared management and compliance with other instruments of territorial planning (Brasil, 2010a).

In accordance with the determinations of the PNRS, PERS have a planning horizon of 20 years, with reviews every four years, and must be in line with other policies and laws instituted in the state. Moreover, considering the planning chain in the three federative spheres, it would be up to PERS to address, notably, the incentives for regionalization of solid waste management, the establishment of goals and state programs, as well as the identification of possible areas that are suitable for the installation of sanitary landfills and of contaminated areas that require recovery (Malvestio *et al.*, 2012).

In recognition of the PERS as a fundamental instrument for state planning, Table 1 and Figure

4 present the scenario of the situation of PERS in the federal units.

The existence of only two thirds of the PERS approved despite the PNRS requirement that all states must establish such planning exposes the fragility of the implementation of this instrument and of the PNRS itself. Even a decade after the enactment of the PNRS, the lack of consistency generated by the non-existence of the PLANARES still resonates, and makes the documents less consonant, since there was no document of reference on which the states could base themselves.

Considering the two-year deadline for the PERS to become a requirement for access to federal resources under the article 55 of the PNRS, only 14.81% of the PERS were prepared during this period, which points to possible state difficulties in the planning process. This fact reveals another weakness of the PNRS implementation, which did not foresee linked planning deadlines for the three federative spheres, resulting in the processes running in parallel and not necessarily in consonance.

Therefore, the planning sequencing in the three spheres is harmed, as well as the subsidies for the creation of consortium solutions and for the elaboration of PMGIRS.

3.1.3 Municipal Plans for Integrated Solid Waste Management - PMGIRS

The municipal autonomy over the management of solid waste in their territory was boosted by the decentralization process of Brazilian environmental policies initiated in the 1988 Federal Constitution (Scardua & Bursztyin, 2003).

TABLE 1 - Status and year of publication of the Solid Waste State Plans.

Solid Waste State Plans		
State	Status of the plan	Year of publication
Acre	Available	2012
Maranhão	Available	2012
Pernambuco	Available	2012
Rio Grande do Norte	Available	2012
Paraná	Available	2013
Rio de Janeiro	Available	2013
Pará	Available	2014
Santa Catarina	Available	2014
Sergipe	Available	2014
São Paulo	Available	2014
Rio Grande do Sul	Available	2015
Alagoas	Available	2016
Ceará	Available	2016
Goiás	Available	2017
Tocantins	Available	2017
Distrito Federal	Available	2018
Espírito Santo	Available	2019
Mato Grosso do Sul	In preparation since 2017	-
Amapá	No information	-
Amazonas	Available*	-
Bahia	In preparation**	-
Mato Grosso	No information	-
Minas Gerais	In preparation since 2012	-
Paraíba	In preparation (draft version from 2014)	-
Piauí	No information	-
Rondônia	In preparation since 2018	-
Roraima	No information	-

* Not available for online access

** The document available on the State Government website is that of the Regionalization of Integrated Solid Waste Management (2014), but it does not present a PERS

SOURCE: Elaborated by the authors based on Brasil, 2021.

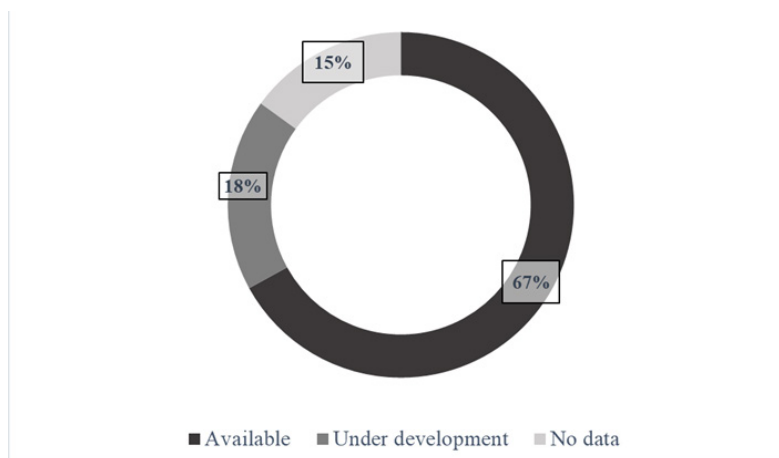


FIGURE 4 - Scenario of the elaboration of the Solid Waste State Plans.

SOURCE: Prepared by the authors based on Brazil (2021).

The Federal Constitution presents in its article 23 - which lists the joint competencies of the Federal Government, the States, the Federal District and the Municipalities - the responsibilities of the federative entities for environmental protection, combating pollution and improving the conditions of basic sanitation. The responsible entities that represent their respective federative entities are, namely, the Ministry of Environment, the State Secretariats of Environment, and the municipalities (Brasil, 1988; Góes, 2011).

In addition to article 23, article 30 of the Constitution defines the municipal competencies for public cleaning services and solid waste management, including collection and environmentally adequate final disposal, as well as the competence to legislate at the municipal level on matters of local interest, such as solid waste management (Brasil, 1988; Góes, 2011; Jacobi & Besen, 2011; Santiago, 2016).

The PNRS, as a result of the decentralization processes of the 1988 Federal Constitution and the decentralized structure of the National Environmental Policy - Law No. 6938/1981 - imputes responsibilities to municipalities. This process is meaningful, since the core of the decision-making process enters in the local sphere, inserts the perspective of regional heterogeneity, and promotes proximity with the citizens, providing improvements in transparency, accountability, and social control.

The PMGIRS is considered a tool of the municipal public administration for the integrated management of solid waste, being the most ramified form of implementation of PNRS, besides being a conditioning factor for the municipality to have access to federal resources (Brasil, 2010a; Costa & Pugliesi, 2018).

The PMGIRS must present a diagnosis of solid waste in the municipality; determinations that guide planning such as: scenarios, goals, and

actions; definition of responsibilities; information on management and operational procedures; in addition to instituting cooperation and economic and financial sustainability of services.

Ten years after the enactment of the PNRS, the scenario of elaboration of PMGIRS is heterogeneous and far from the goal of art. 55 of PNRS, as shown in Figure 5.

The data in Figure 5 show that approximately half of the responding municipalities - according to a survey conducted by the National Sanitation Information System (SNIS) - have not prepared their PMGIRS. Moreover, the very fact that only 62.26% of Brazilian municipalities have filled out this section of the SNIS 2018 shows that municipal weaknesses begin in the diagnostic stage, so that part of the municipalities, especially the smaller ones, far from large centers and poorer, do not even have systematized data. Static and disarticulated municipal structures also make it difficult to plan

for transversal themes, such as solid waste management.

Static and disarticulated municipal structures also make it difficult to plan for cross-cutting issues, such as solid waste management. Thus, even though there is an obligation to prepare PMGIRS, and its obligation to access federal resources, municipal obstacles to the preparation of PMGIRS can be greater or smaller according to each reality, and most of the weaknesses are related to: lack of technical training for the preparation and implementation of plans; difficulty in implementing social participation in the planning and management process; optimization of costs and minimization of impacts of environmentally adequate final disposal; and discontinuity of management (Marshall & Farahbaksh, 2013; Santiago, 2016).

Moreover, one should emphasize that the inexistence of PLANARES, as well as of some of the PERS, also negatively impacts the scenario for

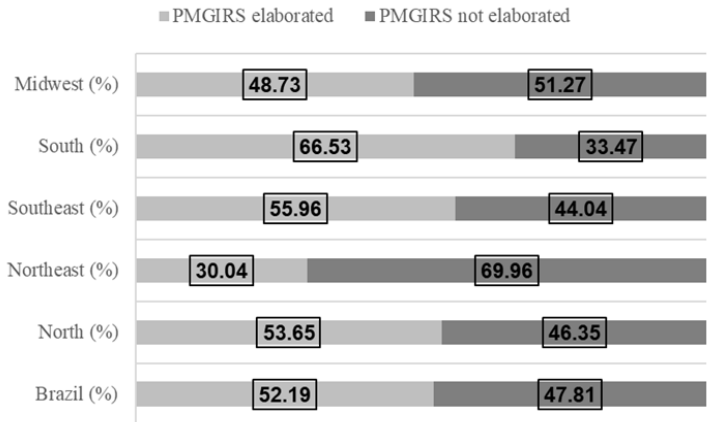


FIGURE 5 - Scenario of PMGIRS elaboration by Brazilian regions.

SOURCE: Elaboration by the authors based on the National Sanitation Information System (SNIS), 2018*.

* The percentage of municipalities responding to this field of the SNIS RS 2018 was: 62.26% for Brazil; 51.78% for the North region; 44.54% for the Northeast region; 71.88% for the Southeast region; 80.77% for the South region; and 58.89% for the Midwest region.

the elaboration of PMGIRS, considering that these would be based on the technical subsidies of the Federal Government and of the states to subsequently outline their specific solid waste management strategy, taking into account their local peculiarities. The planning obstacle, therefore, surpasses the chaining and consonance of the plans, also affecting the consolidation of the local planning process.

Despite the deadline established in art. 55 for the elaboration of state and municipal Plans, currently the federal government does not provide specific public resources for the implementation of PNRS in its central planning instrument, which further weakens the incentive for planning, because, since there are no resources to be accessed, the Plans lose their value as prerequisites. The absence of financial resources, besides weakening the stimulus to planning, can make the implementation of the PNRS unfeasible, especially in small and poorer municipalities, which historically do not have their own resources and have difficulties to access federal funds through ministerial edicts because they do not have technical staff trained in the area.

The inequalities in access to services related to solid waste management will persist without federal investments and support tools for Brazilian municipalities that lack technical capacity and their own resources, and the universalization of the service recommended by Law 11.445/2007, the Federal Policy for Basic Sanitation, will not be achieved (Borja, 2014).

3.2 National System of Information on Solid Waste Management - SINIR

The efficient management of solid waste, in its different levels of territorial organization, needs information for planning, the achieving of objectives and goals, and social control from the guidelines formulated in the PNRS.

Information can be understood as that which results from the processing, manipulation, and organization of collected data, that is, information depends on analysis, consensus, and human measurement (Schneider *et al.*, 2013; Meireles, 2015). In this context, in order to base a sectorial public policy, an information system is a key tool, because it is able to collect and process data, providing information integrated to the different actors involved (Bellingieri, 2012).

SINIR was proposed in the PNRS to improve and qualify solid waste management, as well as to monitor compliance with the targets established in the Waste Plans. It is listed as an instrument of the PNRS to be maintained and organized by the Federal Government, States, Federal District and Municipalities jointly, which are responsible for providing the necessary information about the waste in their sphere of competence (Brasil, 2010a).

This system was established by Decree No. 7.404/2010, under the coordination of the MMA, with an implementation deadline of two years from the publication of the decree. Among the purposes of SINIR, we can highlight collect, sort, generate, store, systematize and share data related to solid waste management; classify them according to importance and confidentiality, aggregating them by federative sphere; make relevant information available, as well as statistics and indicators; enable the evaluation, monitoring and enforcement of solid waste management in its different facets, such as waste plans and reverse logistics; provide informa-

tion to society about the implementation of PNRS, including through the periodic diagnosis "National Inventory of Solid Waste", ensuring transparency and accountability (Brasil, 2010b).

SINIR, therefore, meets some principles of PNRS, placed in the art. 6, highlighting item X "the right of society to information and social control". The content of PMGIRS would also be made available in SINIR, according to art. 18, paragraph 7 of PNRS (Brasil, 2010a).

The electronic address www.sinir.gov.br has been available since May 2013 (Meireles, 2015) and, according to the MMA, the system was officially launched on 26/06/2019 (Brasil, 2019b) and currently features two modules available to gather information: the municipal and the state (SINIR, n.d.).

However, checking the information available in the system, it is observed that SINIR is far from its purposes. For example, the PMGIRS are not available and it is not possible to monitor the data related to their implementation and operationalization. Thus, social control is impaired by the lack, incompleteness and inconsistency among the available information on solid waste in Brazil.

The General Comptroller's Office (CGU), in an Annual Audit report on the Executive Secretariat of the Ministry of the Environment, reports that

Despite meeting the deadline, it was found that this version of the system [SINIR] did not meet the information requirements set forth in the aforementioned Decree [7.404/2010] and neither did it fulfill the foreseen purposes, such as: collect and systematize data related to the provision of public and private solid waste management and administration services; allow and facilitate the monitoring, inspection and evaluation of the efficiency of solid waste manage-

ment and administration at the various levels (Brasil, 2019a, p. 18).

The CGU audit document informs that the MMA signed a technical agreement with the Brazilian Association of Waste and Wastewater Treatment Companies (ABETRE) for the "improvement of SINIR through the development of a municipal module and another state module containing the main data and information of the minimal content of the respective Solid Waste Plans," with delivery forecast for 2019 (BRASIL, 2019a, p. 18).

In June 2021, the SINIR presented three information panels, being:

- (i) Solid Waste Management Panel, which presents municipal information extracted from the SNIS;
- (ii) Flow and Quantity of Waste / Processing Units Panel, which also presents municipal information extracted from the SNIS; and
- (iii) Legal Disposal Panel on Reverse Logistics, which presents information about the recovery of tires and lubricating oil, prepared by the General Coordination of Environmental Information Management of the MMA, as well as information about the recovery of lamps based on data from the Brazilian Association for the Management of the Reverse Logistics of Lighting Products (Reciclus) (SINIR, n.d.).

One can observe, therefore, that there has been progress, notably in the presentation of data related to sectoral agreements and to the progress of reverse logistics. However, the other data presented are extracted from the SNIS, with no improvements,

but only a redirection and presentation in a different platform.

Regarding the agreement signed with ABETRE, even though this type of agreement is cost-free for the MMA, once again a situation of conflict of interest arises, since ABETRE members may be users of the system, since SINIR must present data from public and private actors. In addition, it is noted that the information made available about the agreement does not make clear what the role of ABETRE was in the process, which undermines its transparency and accountability.

From this perspective, this agreement goes in the opposite direction of a national integrated information system, since it would be essential to involve the actors - such as states and municipalities - in the structuring of the system that they will have to feed, as well as in the integration of SINIR with local and regional systems that already exist, avoiding rework.

Another issue that arises from the agreement signed by the MMA is that the focus shifts from the structuring of a system to the simple availability of already existing data or even to the availability in another platform of an already existing national system (SNIS), which may sound like rework and unnecessary expenditure of public resources. Of course, the integration and presentation of existing data is one of the aspects covered by SINIR, but one misses the opportunity to design a system of indicators that effectively meets the needs of the sector (Heller et al., 2004).

In addition, there is no information about the integration of systems such as the SNIS and

SINIR, appearing to be a simple re-presentation of information. Integration is a key part in structuring this system, since the SNIS has had a database with information on solid waste since 2002. There is also no information on the integration of SINIR with IBGE, which also collects data on the sector in the Municipal Basic Information Survey (MUNIC) - Basic Sanitation Supplement.

SINIR's delay and the lack of information for solid waste management in the country accentuate the difficulties of implementing the PNRS and expose the non-prioritization of the theme, indicating that the legislative framework is insufficient to unravel the challenges of the sector. The failures and inefficiency of solid waste management in the country are directly related to the lack and deficiency of data and the consequent impossibility of evaluating the execution of planning.

3.3. Environmentally adequate final disposal

The establishment in the PNRS of the environmentally adequate final disposal of solid waste aims to minimize negative impacts to the environment and implies in sending only the tailings² to landfills, since this solution follows technical standards in its construction and operation that ensure the confinement and landfilling of solid waste, offering less risk to the environment. In opposition, the disposal of solid waste in dumps or open-air dumps has been considered inappropriate since last century by the Brazilian legislation, and we can cite the Penal Code of 1940 which, more broadly, instituted pu-

² The word tailings associated with waste management was defined by the Brazilian law, PNRS, as "[any] solid waste that, after exhausting all treatment and recovery possibilities by available and economically viable technological processes, does not present any other possibility than environmentally appropriate final disposal".

nishment for conducts harmful to public health, and the first National Policy of Basic Sanitation, Law no. 5. 318/1967, covering environmental pollution control, including the, still called, garbage (Marotti, 2018); given that in this case technical standards are not followed, it offers risks to public health due to the proliferation of vectors and negatively impacts the environment, leading to pollution of the soil, water bodies, and air (Jacobi & Besen, 2011; Brasil, 2010a).

The PNRS establishes (art. 54) the goal for implementation of the "environmentally adequate final disposal of waste", to be achieved within four years after the publication of the law - December 2014. Further, in art. 9 it is established the order of priority for the management of solid waste, consisting of: non-generation, reduction, reuse, recycling, treatment of solid waste, and environmentally adequate final disposal of waste. It is noteworthy, therefore, that the environmentally appropriate final disposal of waste is to send to landfills only "solid waste that, after exhausting all possibilities of treatment and recovery by available technological processes and economically feasible, have no other possibility than the environmentally appropriate final disposal" (Brasil, 2010a).

Keeping in mind the difficulty of municipalities to close down dumps and send only tailings to landfills, in 2020, Law No. 14.026, known as the New Sanitation Framework, extended the deadline for the environmentally adequate final disposal of the tailings addressed in art. 54, staggering the deadlines between 2020 and 2024 (Brasil, 2020).

The PLANSAB (Brasil, 2014) addresses the management of solid waste and provides the indicator "R3 - Number of municipalities with the presence of solid waste dumps/total municipalities",

in which it is established that, as of 2018, no municipality would have open air dump sites. However, this scenario is far from the Brazilian reality after more than a decade of PNRS publication. Since there is no data calculated for the indicator proposed in PLANSAB, it was only possible to evaluate the data in the SNIS Solid Waste 2018, which is one of the scarce sources of data in the area.

Thus, Figure 6 presents the relationship between the PLANSAB indicator - goals for 2018 and 2023 - and the SNIS 2018 results for the destination of solid waste to dumpsites in the country as a whole and within each of the five Brazilian regions. Considering that the goal is to close all dumpsites as of 2018 - which is represented in the figure below with the values set to zero in the table and with no data represented in the bar graph - and that the information brought in the SNIS shows that 47.48% of the municipalities that responded to the survey send their solid waste to dumpsites, one can notice differences between the goal set in the plan and the indicator presented in the system.

As for the goal of environmentally adequate final disposal, one can also observe the ineffectiveness of the PNRS because, besides the goal set by law being far from the country's reality, the legislative system did not adjust it promptly when it expired. This scenario generates uncertainty about its current situation, as well as about the governmental actions towards its achievement.

Regarding the Plansab indicator, it was planned to be measured based on the National Survey on Basic Sanitation (PNSB, IBGE), which has not been published since 2008. Furthermore, the year of the goals for this indicator does not match the PNSB years and the SNIS was not considered as an alternative source of data, even though its so-

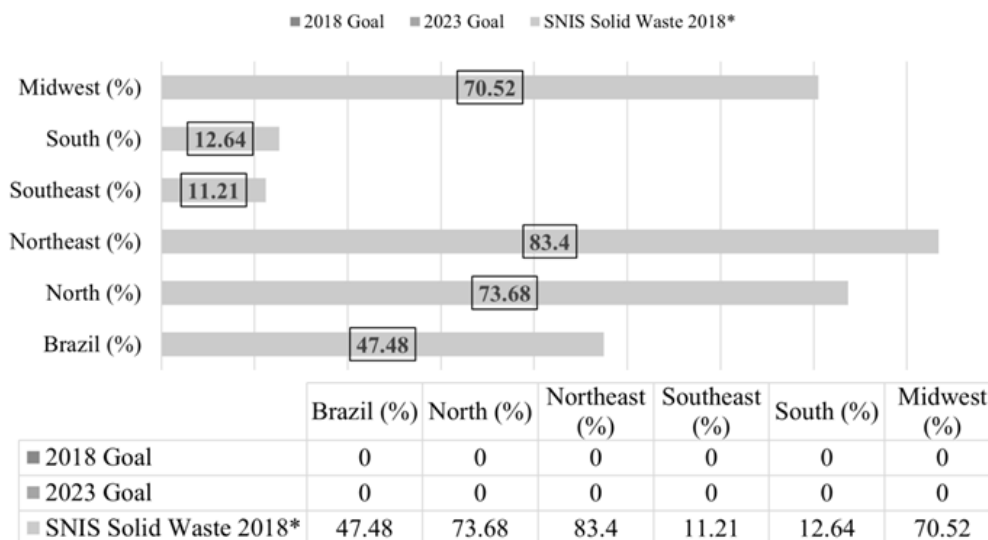


FIGURE 6 - Relation between Plansab goal concerning the presence of dumpsite and information from SNIS Solid Waste 2018.

SOURCE: Prepared by the authors based on Brasil, 2014 and SNIS, 2018.

* The percentage of municipalities that responded to this field of SNIS Solid Waste 2018 was: 39.21% for the country; 46.44% for the North region; 39.30% for the Northeast region; 45.44% for the Southeast region; 21.91% for the South region; and 53.75% for the Midwest region.

lid waste survey has been conducted since 2002. Therefore, one can notice the inconsistency of the planning with reality and the fragility for the effective implementation of the policy.

The Plansab document clarifies that the goals set in indicator R3 were intended to align with the PNRS. Nevertheless, it is highlighted that experts consulted in the preparation of this Plan envisioned less optimistic goals than those established, foreseeing the effective eradication of dump sites as a goal for the year 2033 (Brasil, 2014).

Considering that the goal set in art. 54 is one of the main flagships of the PNRS, the fact that there is no reliable indicator - as opposed to the SNIS that is self-reporting or the PNSB that was discontinued - denotes a detachment between the planning and the

implementation of the policy and efforts that proved to be insufficient for its effectiveness.

One can see, therefore, that the issue of environmentally adequate final disposal of waste is cross-cutting to the PNRS, demanding that other pillars of the legislation should be put into effect to change the Brazilian reality of inadequate final disposal in most of the country. However, this issue is not satisfactorily aligned with key issues such as (i) the effective planning of waste management, (ii) the effectiveness of the order of priority in management, and (iii) the need for a scale to adopt sustainable final disposal solutions, which ends up weakening the implementation of this strategic matter, or even leading to its incomplete implementation, since the investment in a sanitary landfill that receives solid

waste and not just tailings results in a higher cost over time.

3.4. Summary of the results of the three axes of analysis

Based on the results presented in this study, Table 2 presents a summary of the implementation of the PNRS in the three axes of analysis, revealing that the effectiveness was only partial for all of them, even a decade after the promulgation of the legal framework.

Such panorama reinforces that a consistent legislative instrument is not enough to improve solid waste management in the country, making it essential to prioritize this theme in the political agenda, the intra and inter-institutional articulation, as well as the continuity of governmental actions, making it a state policy and not a government policy (Santiago, 2021).

4. Conclusions

The enactment of the National Solid Waste Policy brought the issue to the political agenda and to the attention of society, as opposed to the previous posture of simply keeping solid waste away from population centers. The PNRS introduced an innovative and complex framework, with challenging goals for an existing scenario of negligence.

However, a decade after the law's implementation, the results are modest and the integrated management of solid waste moves at a slow pace.

In the axes of analysis presented - (i) planning, (ii) information system on solid waste, and (iii) environmentally adequate final disposal of waste - it

is possible to glimpse some of the reasons for the partial effectiveness of the PNRS.

The non-existence of the National Solid Waste Plan generates a chain reaction that is harmful to the State and Municipal Plans, as well as to the linkage and the consonance that must exist between them. In turn, the partial effectiveness of SINIR impacts planning, since it presents previously existing and available data, without integrating them with new information, such as from some sectoral agreements, nor even proposing new necessary indicators. This is a sugar-coating alternative, which in turn hinders the adoption of the environmentally adequate final disposal of waste, which is cross-cutting to these themes. Reactive and negligent attitudes increase the social, economic, and environmental costs of this public policy.

Thus, it is observed that the ineffectiveness of the PNRS is directly related to the non-observance of what is foreseen in the letter of the law, weakening the planning spheres and not offering federal subsidies for implementation by the other actors. The absence of mechanisms to "enforce the law", in the case studied, reveals the difficulty of improving the execution of essential environmental public policies, even in the face of their lower visibility on the public agenda.

The lack of support from the federal government itself leads to a lack of mobility of the other government entities in relation to the enforcement and implementation of the law. In this context, we highlight the relevant role of the public inspection agencies - such as the Accounting Courts and the Controllers - as essential to make the observed advances possible.

Finally, we highlight that the effectiveness of the PNRS depends on its prioritization on the public

TABLE 2 - Summary table of the results presented.

Axis of Analysis	Legal Provisions	Deadlines	Responsible parties	Status	
(i) Solid Waste Plans	National	PNRS - Art. 14 Item I; Art. 15 - The National Solid Waste Plan	Not determined	Ministry of Environment	<i>Partial Effectuation</i> It has not finalized its processing, so it has no legal validity. It jeopardizes the sequence of the other plans.
	State	PNRS - Art. 14 Section II; Art. 16 and 17 - Solid Waste State Plans	100% by 2012 (Art. 55)	States	<i>Partial Effectuation</i> 67% of the states have made their PERS available.
	Municipal	PNRS - Art. 14 Item V; Art. 18 and 19 - Municipal Plans for the Integrated Management of Solid Waste; Art. 26	100% BY 2012 (Art. 55)	Municipal	<i>Partial Effectuation</i> 52% of the municipalities affirm having elaborated their PMGIRS.
(ii) SINIR	PNRS - Article XI; Article 12; Article 19 § 7; Article 23 § 2	Launch in 2012 (Decree No. 7,404/2010)	Ministry of Environment (Coordinator)	<i>Partial Effectuation</i> Officially launched in 2019, it has information replicated from the SNIS, in addition to information about the sectoral agreements for tires, lubricating oils and lamps.	
(iii) Goal of environmentally adequate final disposal of the waste	PNRS - Art. 54 / Law 14.026/2020 - Art. 11	2014 (Art. 54, PNRS) 2024 (art. 11, Law 14.026)	All of them	<i>Partial Effectuation</i> 47.48% of the municipalities affirm that they dispose of their solid waste in dumps. Cross-cutting issue, it depends on the entire management functioning, data, planning, order of priority.	

SOURCE: Elaborated by the authors.

agenda in order to resume its implementation, with the federal coordinating institutions acting in their respective competencies and greater articulation of instruments, aiming for environmental, social and economic gains to the country. Hence, studies such as this one can contribute to subsidize the implementation process of the PNRS in different scales, also contributing to the international knowledge sphere on solid waste management.

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