Solid Waste Management of the municipalities of the state of Rondônia in the Western Amazon – Brazil

https://doi.org/10.56238/sevened2024.004-020

Lucelia Largura do Vale Vidigal[1]

ABSTRACT

The approach of this study was the management of urban solid waste in municipalities in the state of Rondônia – Western Amazon – Brazil. The main objective was to analyze the management of solid waste in accordance with PNRS Law 12.305/2010 in municipalities in the State of Rondônia. The research established the Municipal Index (IM) and the General State Index (IGE) for each municipality. In the aspects of Strategic Management and Collection and transportation, the IGE was 0.47 and 0.39 respectively, considered a BAD performance for Rondônia, whereas Sorting and Treatment and Final Destination the IGE was 0.24 and 0.27, classifying them like TERRIBLE. Unsatisfactory results may result from the absence or poor management of the municipal solid waste plan and its resources, inadequate disposal of waste, including open dumps, little investment in a selective and cooperative waste collection system, among others. The main contribution of the research was to observe the critical points that require greater attention so that MSW managers can establish or prioritize the most urgent points that require action, create or improve an Integrated Municipal Solid Waste Plan that meets the demands of society , developing and including cooperatives and associations of collectors, reducing environmental impacts and the health of the population, controlling or minimizing the municipality's costs with landfills and eliminating open dumps.

Keywords: Municipal Management, Solid waste management, National Solid Waste Policy.

[1] Professor at the Federal University of Rondônia (UNIR). Master's degree in Business Administration from the Faculty of Studies in Administration of Minas Gerais (FEAD).
E-mail: lucelia.vale@unir.br

INTRODUCTION

For some time now, there has been a growing concern about the impacts that waste has been causing to society, the economy and the environment, authors such as Leite (2002), argues that different ways of reusing garbage should be adopted, either to produce something new, using garbage as raw material, or with the use of "second-hand" products. Neto and Moreira (2010) describe that the increase in population and migration to cities has changed the consumption profile and, consequently, its disposal.

The issue of solid waste is something that has plagued humanity since antiquity for Pereira (2019), especially the issue of sanitation is often responsible for soil contamination and the proliferation of diseases, affecting people's health. In this regard, Cunha (2018) points out that in Brazil public policies are backward and little has been done for decades. However, the National Solid Waste Policy – PNRS Law 12.305/2010 became a milestone, as it presented guidelines for the better organization of waste and its concept, where waste is considered to be that which no longer presents any possibility of reinsertion into the production cycle again, which ultimately needs environmentally appropriate final disposal.

In Brazil there are more than 5,700 municipalities throughout the territory that need support in the most diverse situations, Tullio (2019) argues that the Municipal Solid Waste Plans are more detailed, as it is necessary to recognize the waste generating agents and differentiate the waste that can be classified as hazardous from non-hazardous. Silveira and Clementino (2017) describe that in PNRS Law 12.305/2010, it was provided that by the year 2012 all municipalities in the country should have prepared their plans and that by 2014 all open waste disposal would be eradicated. Most Brazilian cities have not complied with this law. The IBGE (2019) shows that only 54.8% of municipalities effectively have an Integrated Solid Waste Management Plan.

Therefore, the questions about the problem of solid waste in Brazil are to find adequate solutions to the dilemma of this century, the destination of waste from consumption. For this, it was necessary to know how the municipalities in the State of Rondônia – Western Amazon/Brazil, manage Urban Solid Waste in accordance with the National Solid Waste Policy – PNRS, Law 12.305/2010. To this end, the general objective of this study was to analyze the management of solid waste according to PNRS Law 12.305/2010 in the municipalities of the State of Rondônia - Western Amazon/Brazil. The specific objectives were: to raise with the municipalities the adoption of solid waste management policy measures in attention to local demands in waste management, in line with Law 12.305/2010 of the municipalities of the State of Rondônia - Western Amazon/Brazil (a); identify the existence of actions that involve the community and people's sensitization to the problems related to GRSU in the municipalities of the State of Rondônia - Western Amazon/Brazil (b); and to seek, under the analysis of the urban solid waste manager of the municipalities of the

State of Rondônia - Western Amazon/Brazil, the conditions of strategic management, collection and transportation, sorting and final disposal of MSW in each city studied (c).

An inductive method supported by Medeiros (2018), Gil (2019, p. 12), Lakatos (2018) was used, and a descriptive method was based on Vergara (2010), Kauark, Manhões, Medeiros, (2010) and (Andrade, 1997), having qualitative and quantitative. Data were collected using a semi-structured form adapted from Ferraz (2008) in his model for the evaluation of integrated municipal management of urban solid waste and Barroso (2013) in Contributions to Solid Waste Management in the State of São Paulo, the research was applied to those responsible for solid waste management in all municipalities with a population above 20,000 inhabitants, totaling 21 in the state of Rondônia. The study took place during the Covid-19 Pandemic period. The research was characterized as being Census, as Gil (2009) and Lakatos (2018) discuss, in a census survey, sampling does not occur.

The contribution of this study was to establish for each municipality the Municipal Index (MI) and the General State Index (IGE), making it possible to quantify and qualify the situation of each one considering the aspects of Strategic Management, Collection and transportation, sorting and treatment and the final destination.

THEORETICAL-EMPIRICAL FRAMEWORK

The main theoretical bases that support this study are presented especially in this chapter. Thus, a presentation is initially made on the main previous studies developed on the National Solid Waste Policy, which includes the Municipal Plans for Urban Solid Waste. Next, the main Laws, resolutions and Decrees that serve as a contribution for all municipalities in the Brazilian territory in the construction of management strategies to give an adequate final destination to the waste produced daily, in order to reduce, mainly, the impacts on the environment and the health of the population. The chapter also covers the contents of the National Solid Waste Plan, State Solid Waste Plans, and the Municipal Plan for Integrated Solid Waste Management.

CONCEPTS AND DEFINITIONS: GARBAGE AND MUNICIPAL SOLID WASTE

Before defining solid waste, it is necessary to understand some concepts that may facilitate its conceptualization, for some, waste, garbage, remains, rubble, debris and/or leftovers. There are several words used for its name. For Aurelius (2020), The Garbage refers to any Material without value or utility, or waste from domestic, industrial and other work that is thrown away, or even everything that is removed from a place to leave it clean. The fact is that humanity's relationship with its biosphere has been progressively transforming over time in the same proportion as production and consumer growth to meet people's needs. After the Industrial Revolution began in the mid-eighteenth century, the creation of machinery and equipment that provided an exponential increase in waste

became a major problem in society. MAGERA (2003)

The big bottleneck is in the scenario that most of this waste is not even sent for these purposes, such as reuse or recycling. According to studies presented by UN-Habitat (2018), more than 2 billion tons of waste are produced worldwide every year, at the meeting that took place on October 1, 2018, energetic changes in the consumption pattern were demanded to combat excess garbage in cities, highlighting the importance of "Municipal Solid Waste Management". Another alarming fact from the same survey is that 99% of the products that are purchased are thrown away in 6 months, and to accommodate 7.6 billion inhabitants in the world, supply the use of resources and absorb the garbage generated, it would be necessary to have 70% of another planet like ours. That is why it is necessary for countries, states and municipalities around the world to jointly seek urgent solutions for effective waste management.

Currently, billions of people do not have access to public basic sanitation services, such as drinking water supply, collection, transport and their final disposal. Much of this same population suffers from diseases related to the inadequate distribution of water and sewage. Issues related to this theme have been shown to be one of the most backward public policies. WEDGE (2018)

SOLID WASTE

The definition of Solid Waste is basically represented by the materials discarded by people, where they can be recycled and/or partially used, having as main benefit the protection of health, economy as well as the preservation of the environment.

The PNRS (2010) also introduced a new concept of "tailings", where, according to the text, they are solid waste that, after exhausting all possibilities of treatment and recovery by available and economically viable technological processes, presented no other possibility than environmentally appropriate final disposal. To this end, the PNRS addresses a set of characteristics and properties listed in the table below. Although the term emphasizes the adjective solid to the term waste, the PNRS includes other states of matter in the definition of solid waste.

Table 1: Characteristics and properties of Solid Waste according to the PNRS

Feature	Property
Discarded material, substance or good.	It requires action, a positive act that involves the disposal of something that is under your administration, use, power;
Resulting from human activity in society.	If it is not something resulting from human activity in society, it cannot be understood as waste, like animal excrement in the jungle;
If it proceeds, if it proposes to proceed or if it is obliged to proceed with its final disposal.	From disposal follows the need for final destination, whether by voluntariness (proceeds and proposes to succeed) or by obligations
There are no solid, semi-solid states, gases contained in containers and liquids that cannot be disposed of in the public sewage system or bodies of water.	Despite the term emphasizing the adjective solid to the term exclusion, the PNRS includes other states of matter in the definition of solid elimination.

Source: Silva Filho and Soler (2012), adapted.

For the Brazilian Association of Technical Standards – ABNT: Solid waste is waste in solid and semi-solid states, which result from community activities, of origin: industrial, domestic, health services, commercial, agricultural, services and sweeping. (ABNT, 2004)

Law 12.305 of August 2, 2010 defines it as: "Material, substance, object or discarded good resulting from human activities in society, and which need to be disposed of". The legal framework for basic sanitation in Brazil was instituted by the National Basic Sanitation Law (LNSB), Federal Law No. 11,445, of January 5, 2007 and regulates years later through Federal Decree No. 7,217 of June 21, 2010, and brings that basic sanitation is a set of infrastructures and operational facilities: (i) drinking water supply; (ii) sanitary sewage; (iii) urban cleaning and solid waste management; drainage and rainwater management, preventive cleaning and inspection of urban networks. MARCHI (2018)

Only after 20 years of discussion in Brazil was Federal Law No. 12,305 of August 2, 2010, called the National Solid Waste Policy (PNRS), which establishes principles, objectives, instruments, guidelines related to integrated management and management of solid waste (it also includes hazardous waste, with the exception of radioactive waste that has its own legislation). as well as the responsibility of those who generate, the public authorities and some applicable economic instruments. The PNRS is part of the National Environmental Policy, which is articulated with the Environmental Education Policy, the Federal Basic Sanitation Policy and the Public Consortium Law.

It is important to understand that the Law that establishes the PNRS are a set of provisions, principles, objectives and guidelines, however, the normative issue is not exclusively hers, it is necessary to observe some instruments and guidelines as listed in the following table.

Chart 2: Laws, guidelines, regulations preceding the PNRS/2010

Laws/Decrees	Goal
Law no. 11,445 of January 5, 2007	Establishes national guidelines for basic sanitation and federal basic sanitation policy.
Federal Law no. 6,938, of August 31, 1981.	Provides for the National Environmental Policy, its purposes and formulation and application mechanisms;
Federal Law no. 9,605, of February 12, 1998.	Provides for criminal and administrative sanctions arising from conduct and activities harmful to the environment;
Federal Law no. 9,795, of April 27, 1999.	Provides for environmental education, establishes the National Environmental Education Policy;
Federal Law no. 10,605, of April 16, 2003.	Provides for public access to data and information existing in bodies and entities that are part of Sisnama;
Federal Law no. 11,079, of December 30, 2004.	Establishes general rules for bidding and contracting public-private partnerships within the scope of public administration;
Federal Law no. 11,107, of April 6, 2005.	Provides for general rules for contracting public consortia;
Complementary law no. 101, of May 4, 2000.	Establishes public finance standards aimed at responsibility in fiscal management;
Complementary law no. 123, of December 14, 2006.	Establishes the National Statute for Microenterprises and Small Businesses;
Federal Decree no. 6,514, of July 22, 2008.	Provides for environmental infractions and administrative sanctions, establishes the federal administrative process for investigating these infractions;
Federal Decree no. 7,217, of June 21, 2010.	Feature
Property	Material, substance or discarded good.

Source: Silva Filho and Soler (2012), adapted.

The topic of solid waste is carried out through various legal and normative instruments. In addition to the laws and decrees mentioned, there are also some standards that are established by agencies such as: the National Environmental System (Sisnama), the National Health Surveillance System (SNVS), the Unified System of Agricultural Health Care (Suasa) and the National System of Metrology, Standardization and Industrial Quality (Sinmetro).

CLASSIFICATION OF WASTE

There are several classifications for solid waste that are basically determined by their characteristics or the identification of properties, and these are determinant for the choice of management strategies appropriate to each one. NBR 10004/2004 classifies solid waste according to its degree of hazard, that is, according to its physical, chemical and infectious properties, as well as the possible risk to people's health and the environment. Table 3 below shows the classifications according to the hazardousness of solid waste.

Table 3: Classification of solid waste according to its hazardousness

It demands action, a positive act that implies the disposal of something that is under its administration, use, power;		**Resulting from human activity in society.**
If it is not something resulting from human activity in society, it cannot be understood as waste, like animal excrement in the jungle;	If it proceeds, if it proposes to proceed or if it is obliged to proceed with its final destination.	From the disposal onwards, the need for final destination follows, either by voluntariness (proceeds and proposes to succeed) or by obligation
In the solid, semi-solid state, gases contained in containers and liquids that cannot be disposed of in the public sewer system or in water bodies.	Although the term emphasizes the adjective solid to the term waste, the PNRS includes other states of matter in the definition of solid waste.	-
Class II A	Not Inert	They have biodegradability, combustibility and water solubility properties.
Class II B	Inert	Those considered inert or non-combustible.

Source: NBR 10004/2004.

The PNRS of Law 12.305/2010 also provides a classification regarding the origin and its dangerousness, as presented below.

Table 4: Classification of solid waste according to its origin

Laws/Decrees	**Objective**
a) Law No. 11,445 of January 5, 2007	Establishes the national guidelines for basic sanitation and federal basic sanitation policy.
b) Federal Law No. 6.938 of 31 August 1981.	Provides for the National Environmental Policy, its purposes and mechanisms for formulation and application;
c) Federal Law No. 9,605, of February 12, 1998.	Provides for criminal and administrative sanctions derived from conducts and activities harmful to the environment;*a* e *b*;
d) Federal Lions n. 9,795, of 27 abril of 1999.	Provides for environmental education, institutes the National Policy for Environmental Education;*b*, *e*, *g*, *h* e *j*;
e) Federal Lions n. 10,605, of 16 abril of 2003.	Provides for public access to existing data and information in the bodies and entities that are part of Sisnama;*c*;
f) Federal Law No. 11,079, of December 30, 2004.	Establishes general rules for bidding and contracting of public-private partnerships within the scope of public administration;
g) Federal Lions n. 11.107, of 6 abril of 2005.	Provides for general rules for contracting public consortia;
h) Complementary Law No. 101 of May 4, 2000.	Establishes public finance standards aimed at responsible fiscal management;
i) Complementary Law No. 123 of December 14, 2006.	Establishes the National Statute of Micro and Small Enterprises;
j) Federal Decree No. 6,514, of July 22, 2008.	Provides for environmental infractions and administrative sanctions, establishes the federal administrative procedure for the investigation of these infractions;
k) Federal Decree No. 7,217, of June 21, 2010.	Regulates Law 11.445, of January 5, 2007, which establishes national guidelines for basic sanitation.

Source: PNRS/2010, Law 12.305, adapted.

In addition to classifying the PNRS Law, it also distinguishes between hazardous and non-hazardous waste, as provided in the table, namely:

Table 5: Classification of solid waste according to hazardousness

Federal Decree No. 7,704, of December 23, 2010.	**Regulate Law No. 12,305, of August 2, 2010, which establishes the National Solid Waste Policy and the Committee Oriented to the Implementation of Reverse Logistics Systems.**
a) Hazardous waste	Those that, due to their characteristics of flammability, corrosiveness, reactivity, toxicity, pathogenicity, carcinogenicity, teratogenicity, mutagenicity, present a significant risk to public health or environmental quality, in accordance with the law, regulation or technical standard;
b) Non-hazardous waste	Those not included in paragraph a;

Source: PNRS, Law 12.305/2010, adapted.

One of the objectives of the Law is to reduce the volume and hazard of hazardous waste, precisely because of the imminent risk to people (public health) and the environment. However, there are more objectives that are part of it, such as: adoption of development and improvement of clean technologies, in order to minimize environmental impacts; encouraging the adoption of sustainable patterns of production and consumption of goods and services; protection of public health and environmental quality; non-generation, reduction, reuse, recycling and treatment of solid waste, as well as environmentally appropriate final disposal of waste; encouraging the recycling industry, with a view to promoting the use of raw materials and inputs derived from recyclable and recycled materials; and put an end to integrated solid waste management. SILVA FILHO AND SOLER (2012)

Integrated Solid Waste Management: National, State and Municipal

Currently, IBGE (2020) shows that 68% of Brazilian cities have less than 20 thousand inhabitants, where 80% of them live in urban areas. The PNRS (2010), Section IV, article 19, item IX, paragraph 2 of the Municipal Solid Waste Plans states that *"§ 2 For municipalities with less than twenty thousand inhabitants, the municipal plan for integrated solid waste management shall have simplified content, in the form of the regulation."* This opening of the Law, together with the Brazilian reality in relation to the substantial number of municipalities with smaller populations, raises concerns about urban environmental problems, including the management of solid waste, which is the responsibility of municipal public administrations.

Therefore, on August 3, 2012, the elaboration of Integrated Solid Waste Management Plans was foreseen: National, State and Municipal, where these should be in accordance with the terms of the PNRS Law. SANTAELLA (2014)

National Solid Waste Plan

The National Solid Waste Policy (PNRS), which was regulated by Decree No. 7,404 of 2010, created an important instrument, which was the National Solid Waste Plan, and established the Interministerial Committee (IC), coordinated by the MMA. This plan has a close relationship with the National Climate Change Plan (PNCM), Water Resources Plan (PNRH), Basic Sanitation Plan

(Plansab), and Sustainable Production and Consumption Plan (PPCS). They contain, according to the aforementioned Law, the proposals for various sectors of the economy, making economic growth and environmental preservation compatible.

The National Solid Waste Plan shall be prepared by the Federal Government under the coordination of the Ministry of the Environment (MMA), which shall be valid for an indefinite period, with a horizon of 20 years and updated every 4 (four) years. Article 15 of Section II, items I to XI of the PNRS/2010, assigns a minimum content of:

Briefly, the National Plan includes guidelines, strategies, goals with indications of actions necessary for the implementation of the national objectives as well as their priorities, serving as a guide for other public responsibility plans, including solid waste plans. IBAM (2001)

It is important to emphasize that planning must exist at all levels, from the national to the local, to the planning and management of different types of waste, and must contain the National Plan, State Plan and Municipal Plans. Also at the municipal level, there may be, if necessary, Intermunicipal, Micro-regional, Metropolitan Regions and Urban Agglomeration Plans, as can be seen in figure 4 below.

Figure 1: Hierarchical Structure of the Solid Waste Plans according to PNRS/2010.

	PRAZOS				
ESFERA	**Plano**	**Elaboração**	**Vigência**	**Horizonte de atuação**	**Atualização ou Revisão**
Federal	Plano Nacional de Resíduos Sólidos	Versão preliminar até junho de 2011	Indeterminado	20 anos	A cada 4 anos (previsão)
Estadual	Plano Estadual de Resíduos Sólidos	Agosto de 2012 A elaboração é condição para o acesso dos Estados aos recursos da União, ou por ela controlados.	Indeterminado	20 anos	A cada 4 anos (previsão)
	Plano Microrregional de Resíduos Sólidos				
	Plano de Resíduos Sólidos de Regiões Metropolitanas ou Aglomerações Urbanas				
Municipal	Plano Municipal de Gestão Integrada de Resíduos Sólidos	Agosto de 2012 A elaboração é condição para o acesso dos Municípios aos recursos da União, ou por ela controlados.	Indeterminado	20 anos	Prioritariamente, no máximo a cada 4 anos, junto com a revisão do plano plurianual. *Esta exigência, para o âmbito local, faz do PGIRS uma peça viva, que se reinventa a cada nova discussão pública, renovando o repertório de conhecimento sobre o assunto por parte da comunidade; incorporando novas tecnologias nos processos de gestão, manejo, processamento e destinação final; incorporando novos procedimentos e descartando os que já não mais se mostrem eficientes ou viáveis.*
	Plano Intermunicipal de Resíduos Sólidos *Municípios com menos de 20 mil habitantes poderão adotar planos simplificados de gestão de resíduos sólidos.*				

Source: MMA (2012, p. 45)

The Federal Constitution (1988), in its article 30, item V, provides for the competence of municipalities to "organize and provide, directly or under a concession or permission regime, public services of local interest, including public transport, which has an essential character". The characterization of the definition of "local interest" is the predominance of the interests of the municipality over the interests of the State or the Union. Thus, among these interests are urban

cleaning, which can be managed directly by the municipality; by a specific public company or through a mixed-capital company acting specifically to act in this function.

Also, without mentioning the word "garbage", the Federal Constitution of 1988, articles 196, 225 and 23, items VI, IX, and X, respectively in its wording states that, "health is a right of all and a duty of the State, guaranteed through social and economic policies aimed at reducing the risk of disease and other health problems and universal and equal access to actions and services for its promotion, protection and recovery", another part, "Everyone has the right to an ecologically balanced environment, a good for the common use of the people and essential to a healthy quality of life, imposing on the Public Power and the community the duty to defend and preserve it for present and future generations", finally, "It is the common competence of the Union, the States, the Federal District and the Municipalities: protect the environment and combat pollution in any of its forms; promote housing construction programs and the improvement of housing conditions and basic sanitation; tackling the causes of poverty and the factors of marginalization by promoting the social integration of disadvantaged sectors."

Therefore, the Integrated Management of the Urban Cleaning System involves the population and the systematic political exercise that are linked to the municipal, state and federal spheres. In Brazil there is a vast collection of Decrees, Laws, Resolutions and norms that highlight the concern with the environment, some of which are specific to the maintenance of the environment, however forceful actions are needed in relation to them. IBAM (2015)

State Solid Waste Plan

The elaboration of the State Solid Waste Plan (PERS) is provided for in Article 16 of Law No. 12,305/2010, and is an essential condition for the states to have access to federal resources and projects related to solid waste management. Sebrae (2012) mentions that, in essence, the PERS have the same instruments as at the federal level, however, what differs are those of observing the territorial aspects of each state, giving greater emphasis to the definition of guidelines for planning and other solid waste management activities in metropolitan regions, agglomerations and micro-regions.

After the establishment of these micro-regions, the states must coordinate the plans aimed at the municipalities in the way they are organized. It is necessary to carry out studies that define the best locations for the treatment of solid waste and the final disposal of tailings, as well as the recovery of areas affected as a result of inappropriate use.

Article 17 of Section III mentions the scope and validity of the State Plans, a horizon of action that is 20 (twenty) years and a review time of 4 (four) years, and provides the minimum contents of the PERS to be observed in the plans of each state, provided for in items I to XII in Law

No. 12,303/2010 (2017a). The State Solid Waste Plans (PERS) must be based on guidelines that integrate environmental policies, with the policies of the most diverse sectors of the government, the productive sector and civil society, with transparency in order to give legitimacy to the process. SEMAS (2012)

Municipal Plan for Integrated Solid Waste Management

For Tullio (2019), public policies linked to laws, norms and guidelines, inspection bodies are essential for organizing the waste structuring process in Brazil, but there are more than 5,700 municipalities throughout the territory that need to be supported in the most diverse situations. There is a lot of complexity when it comes to correctly disposing of solid waste, starting with handling, packaging and storage. It continues in relation to collection, types of transport, industrial organization for reuse and recycling, even though there are numerous legislations some for individuals and others for legal entities, it is essential that the manager prepares a management plan of which the actors work together to give correct destination to the waste.

The Municipal Solid Waste Plans (PMRS) are more detailed, as they require the identification of favorable areas for adequate final disposal and with less impact on the environment, it must also contain the identification of possible solutions consortium or shared with other municipalities that can be implemented. At this point in the plan, it is necessary to recognize on site the waste generating agents that must present particular plans, in case they produce specific waste (such as construction remains, hospital waste, among others), or hazardous waste.

Data provided by IBGE (2017) through the Ministry of the Environment show that (54.8%) of the municipalities have an Integrated Solid Waste Management Plan. The article published by the MMA website (2019), reinforces that "the presence of the plan is greater in municipalities with larger populations, ranging from 49% of municipalities with 5 thousand to 10 thousand inhabitants, to 83%, in those with more than 500 thousand inhabitants" and when related to the regions of the country highlight that, "Among the regions, the highest percentages are the municipalities in the South (78.9%), Midwest (58.5%) and Southeast (56.6%). Below the national average are the North (54.2%) and Northeast (36.3%) regions." Monteiro (2006) observes that there are numerous deficiencies in the conduct of waste plans (planning and programming) in the medium to long term. Municipalities, particularly the smaller ones, suffer in their economic and managerial capacity, which prevents them from carrying out an adequate work of solid waste management. The same author clarifies that legislation aimed at environmental conservation is abundant, but what prevents it from proceeding most of the time is the interpretation and compliance by public authorities.

Data from ABELPRE (2019) show that almost three-quarters of Brazilian municipalities carry out some type of selective collection, however, in most of them they are not able to serve all neighborhoods, according to data shown in the table below.

Table 1: Number of municipalities with selective collection

Regions	North		North East		Midwest		Southeast		South		Brazil	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Yes	270	286	902	978	209	227	1.464	1496	1.078	1.083	3.923	4.070
No	180	164	892	816	258	240	204	172	113	108	1.647	1.500
Total	**450**		**1.794**		**467**		**1.668**		**1.191**		**5.570**	

Source: Abrelpe (2019, p. 15).

It is possible to notice that although many municipalities still do not offer collection services, on the other hand, in all regions there was an increase between the years 2017 and 2018, with emphasis on the northeast and midwest regions of the country. Being more specific in the North Region, Abelpre (2019) in its report shows that the number of municipalities with selective collection in 2017 was 270 and in 2018 this data rose to 286 out of a total of 450 municipalities, even with an advance many localities still do not have any selective collection system.

METHODOLOGY

In this chapter, the methodological design used for the development of the research of this article is described, such as: approach, scientific method, application of the research, application of the research form, data collection and the criteria for analysis and interpretation of the data. For analysis, charts, graphs and tables were made, later interpreted and discussed in the form of text. For the municipal and state indexes, the formula developed by the author was used.

Table 6: Methodological description of the research

Those not covered by point	Description
Approach	Regarding the approach to the problem, the work was characterized as qualitative and with quantitative aspects and described. Contributed by Severino (2016, p. 125), Figueiredo et al. (2014), (Gerhardt & Silveira, 2009, p.32) and Oliveira (2002).
Scientific Method	Documentary research, bibliographical research and semi-structured form conceptualized by Lakatos (2018), Santos (2000); Gil (2009).
Application of research	It was a census survey, as Gil (2019, p. 102) explains, since the form was applied in all municipalities in Rondônia with a population above 20,000 inhabitants in accordance with PNRS Law 12,305/2010. Lakatos (2018), adds that in a census survey there is no sampling.
Application of the survey form	Semi-structured form adapted from Ferraz (2008) in his model for evaluating integrated municipal management of urban solid waste and Barroso (2013) in Contributions to Solid Waste Management in the State of São Paulo.
Data collect	Procedure for collecting data through the application of already tested instruments, applied to MSW managers in 21 municipalities in the state of Rondônia. The interviews took place via telephone calls, virtual meetings via Google Meeting, video and telephone calls via WhatsApp due to the Covid-19 pandemic period.
Analysis and interpretation and presentation of data	For analysis, a chart, graphs and tables were created, later interpreted and discussed in text form. For municipal and state indices, the formula developed by the author was used.

Source: Prepared by the authors, (2024).

To contemplate each technique selected for the survey and investigation process, it was necessary to establish the categories to be analyzed in the research form, which were: Strategies/Actions; Collection and transportation; Screening and Treatment and Final Disposal. Each category/criterion was divided into subcategories so that it was possible to better enter into the solutions and problems by city, established in the table below:

Table 7: Research categories and subcategories.

Nº	Category/criteria	Subcategory
01	Strategies/Actions	Master plan
		Execution plan
		Institutional Structure
		Organizational Structure/Resource Allocation
		Human Resources Training
		Financial Management and Costs
		Social inclusion policy
		Environmental education
02	Collection and Transport	Waste characterization and analysis
		Domestic Waste Collection System
		Health Waste Collection System
		Construction Waste Collection System
		Bulky Waste Collection System
		Hazardous and Special Waste Collection System
		Sweeping, pruning and Urban Cleaning System
		Maintenance and conservation of equipment
		Human Resources, hygiene and safety
		Assessment of performance, quality and productivity
03	Screening and Treatment	Selective Collection – Qualitative and Quantitative Analysis
		Sorting Plant Qualitative and Quantitative Analysis
		Composting Plant
		Civil Construction Waste Recovery Plant: qualitative and quantitative
		Health Waste Treatment System
		Operating Conditions of Waste Treatment and Recovery Plants
		Operational support for waste picker and scrap dealer cooperatives
04	Final destination	Environmental Licensing
		Environmental Impacts: Domestic Waste Landfill
		Operational Conditions for Final Disposal of Domestic Waste
		Operational Conditions for Final Disposal of RSS Waste
		Operational Conditions for the Disposal of Civil Construction Waste - Rubble
		Operational Conditions for the Disposal of Bulky and Unusable Waste
		Operational Conditions for the Disposal of Special and Hazardous Waste
		Maintenance of Machines and Equipment

Source: Prepared by the authors, (2022), based on Ferraz, (2008).

With the score of each municipality, we sought to establish the municipal index of each city in relation to the analysis carried out by its managers, to measure the municipal performance resulting from the management of the MSW.

a) To arrive at the index for each municipality, the following equation was used:

- PM = Maximum possible score of the municipality
- MI = Index of the municipality
- T = Total score achieved by the municipality

Then:

$$IM = T/PM$$

b) To arrive at the **General Sum in the State (SGE),** the score of each criterion in each municipality studied was added. To find the **General State Index (GSI),** the following was adopted:

- IGE = General State Index
- SGE = General Sum in the State
- *PMG = Maximum Overall Possible Score
- NIA = Number of criteria analyzed

* To find the **Overall Maximum Score (PMG),** the maximum score that each municipality can achieve is multiplied by the number of municipalities. This includes:

IGE = (SGE/PMG)/NIA

After finding the index of each municipality and state, which can vary from 0.00 to 1.00, a simple scale was established to determine the condition of each one, enabling an analysis of the general (state) or individual (municipality) performance using:

- **Terrible:** 0.00 to 0.29
- **Poor:** 0.30 to 0.49
- **Regular:** 0.50 to 0.69
- **Good:** 0.70 to 0.89
- **Optimal:** 0.90 to 1.00

Table 8 - Description of the hypotheses proposed for the study

Hypotheses	Director
H1 - The municipalities in the State of Rondônia - Western Amazon/Brazil in their Integrated Municipal Solid Waste Plans do not meet local demands in waste management caused by the inefficient management of their plans. H2 - The municipalities in the State of Rondônia - Western Amazon/Brazil, in their Integrated Municipal Solid Waste Plans, partially meet local waste management demands due to lack of technical knowledge. H3 - The Integrated Municipal Solid Waste Plans in the municipalities of the State of Rondônia - Western Amazon/Brazil do not meet the guidelines established in the National Solid Waste Policy. H4 - Most of the municipalities in the State of Rondônia - Western Amazon/Brazil do not have a solid waste management plan and therefore do not comply with PNRS Law 12,305/2010.	1.1 1.1 National Solid Waste Policy Law 12,305/2010.

Source: Prepared by the authors (2024).

PRESENTATION OF THE RESEARCH OF THE RESULTS

In this chapter, the collected data will be presented, as well as the results from the study, focused on meeting the objectives listed, as well as the research problem, the validation and/or refutation of the hypotheses. It was sought to identify, from the manager's own point of view, the conditions of urban solid waste management, focusing on Strategic Management, Collection and Transportation, Sorting and treatment and Final Disposal in compliance with Law 12.305/2010 of the National Policy on Urban Solid Waste in the State of Rondônia.

CHARACTERIZATION OF THE MUNICIPALITIES SURVEYED

The study was concentrated in 21 of the 52 municipalities in the state of Rondônia, since Law 12.305/2010, in section IV, art. 19, § 2, says that "For municipalities with less than twenty thousand inhabitants, the municipal plan for integrated solid waste management will have simplified content, in the form of the regulation." Currently, according to the survey, more than 70% of Brazilian cities currently have less than 20 thousand inhabitants, where 80% of them live in urban areas.

Thus, all the other municipalities were surveyed, considering that the estimated population of each one is above 20,000 people and that, therefore, all of them should already have an Integrated Municipal Plan for Solid Waste in compliance with the aforementioned Law, making the survey a census since it contemplated 100% of the cities with these characteristics.

According to IBGE (2021), the municipalities of the State of Rondônia are: Porto Velho (state capital) with 548,952 inhabitants, Ji-Paraná with 131,026, Ariquemes with 111,148, Vilhena with 104,517, Cacoal with 86,416, Rolim de Moura with 55,748, Jaru with 51. 469, Guajará-Mirim with 46,930, Machadinho D'Oeste with 41,724, Buritis with 41,043, Pimenta Bueno with 37,098, Ouro Preto D'Oeste with 35,445, Espigão D'Oeste with 33,009, Nova Mamoré with 32,184, Candeias do Jamari with 28,068, Cujubim with 27,131, São Miguel do Guaporé with 23,147, Alta Floresta D'Oeste with 22,516, Alto Paraíso with 22,258, São Francisco do Guaporé with 21,088 and finally Nova Brasilândia D'Oeste with 20,504 representing 40.38% of the municipalities in the State of Rondônia.

ANALYSIS OF THE MANAGEMENT AND MANAGEMENT OF URBAN SOLID WASTE EVALUATED BY MUNICIPAL MANAGERS IN THE FOLLOWING DIMENSIONS: STRATEGIC MANAGEMENT, COLLECTION AND TRANSPORT SYSTEM, SORTING AND TREATMENT AND FINAL DISPOSAL.

We sought to collect the information under the evaluations of the municipal managers in their respective secretariats aspects of urban solid waste management in each municipality surveyed.

STRATEGIC MANAGEMENT DIMENSION

PNRS 12.305/2010 establishes in its Article 18 that the elaboration of the Integrated Municipal Plan for Solid Waste is the condition for the Federal District, as well as the municipalities, to have access to resources from the Union, intended for projects aimed at urban cleaning, solid waste management, as well as financing to federal credit entities or even promotion for such purpose. In view of this, the first criterion for the analysis of the Strategic Management dimension is the municipal solid waste plan, when all managers were asked if they had a plan, 12 municipalities answered that they did not have one, with a score of 0 (zero) in this item, including the most populous municipality, which is Porto Velho.

Among those that have plans, such as the city of Ariquemes, a score of 5 (five) was assigned in several other items, which shows that the plan requires adjustments. However, two municipalities have an index of 1.00 with EXCELLENT performance, which are Candeias do Jamari and Pimenta Bueno, followed by Cacoal with 0.87 and Nova Brasilândia with 0.78, both on the scale can be classified with GOOD performance, the city of Vilhena also draws attention to the fact that despite

having a Municipal Plan, its index was very low because in the items, defined evaluation indicators, establishes a work plan, defines projects to be implemented, establishes priorities and defines an execution schedule if evaluated with a grade of 0 (zero) lowering its Municipal Index (IM) to 0.21 having VERY POOR performance. Also due to the high number of municipalities with an index of 0.00, the General State Index (IGE) was 0.29, with VERY POOR performance in this criterion.

Another 7 criteria that are related to the understanding of what concerns the execution of the plan, shows that although 12 municipalities have declared that they do not have PMIRS, many of them have some type of informal planning of the activities to be carried out about the MSW in their cities. Now, not all cities have a professional exclusively dedicated to the implementation and monitoring of the plan or even the activities related to MSW.

Regarding the evaluation and updating of the plan, only 3 municipalities evaluated themselves with a score of 10 respectively, the massive majority self-evaluated with 0 (zero), that is, they do not do so, the recommendation of PNRS 12.305/2010 is that the PMIRS be updated together with the municipality's master plan that occurs every 4 (four) years, usually from the beginning of a municipal management. In the general analysis of this criterion, the best **IM** of 0.85 were from Espigão D'Oeste and Ariquemes and 9 (nine) municipalities had **IM** equal to 0 (zero) because they do not have an effective plan, among those who declared to have the **IM** the lowest was Vilhena with 0.35 considered a POOR performance. Or **IGE** in the topic execution of the plan was 0.22, denoting a level of performance classified as VERY POOR for the state of Rondônia.

Following the analysis of the Strategic Management dimension, we sought to understand the way in which the solid waste sectors among the surveyed municipalities are formatted, the criterion institutional structure brought data about the responsible manager, his technical profile, autonomy in decision-making, policies and guidelines, among others. In this criterion, there was no municipality that was evaluated with a score of 0 (zero), and the lowest MI of 0.33 with POOR performance was the municipality of Ouro Preto D'Oeste, where only in the items "adequate allocation" of the sector and "is there a responsible manager" it obtained, suggesting that in this aspect it still has some structuring challenges where it possibly brings negative impacts on the management of MSW. However, two municipalities had an index of 1.00, which were Cacoal and Nova Brasilândia, 0.91 Ariquemes and another 6 had MI of 0.83, which in the performance scale are considered EXCELLENT and GOOD, respectively. However, it should be noted that 8 presented the result with MI between 0.5 and 0.67, considered a REGULAR performance. The IGE also obtained a timid result of 0.69, i.e., a REGULAR performance for the state of Rondônia.

There were 10 municipalities with MI ranging from 1.00 to 0.91 with an EXCELLENT performance index, and 6 with MI results between 0.75 and 0.83 configuring GOOD performance, i.e., the vast majority of managers have a very adequate degree of satisfaction in relation to the

physical facilities of the sector. Only the municipality of Candeias do Jamari obtained a MI of 0.41 considered a POOR performance, although Guajará Mirim, Alto Paraíso and Machadinho D'Oeste had a Regular performance with a MI between 0.5 and 0.58. With the high general municipal indexes, there was an increase in the General State Index – IGE, which stood at 0.82, with GOOD performance.

The training of employees in the MSW sector is of paramount importance for the proper development of work and with quality, both in the administrative sector of the MSW as well as operational, which deals directly with waste and needs technical training as well as preventive training that minimizes risks of work accidents, so the interviewees analyzed three basic aspects that were training and qualification, accident prevention and career plan. It is noteworthy that 3 municipalities that are Guajará Mirim, Ouro Preto D'Oeste and São Miguel did not score in any of these aspects, with a MI of 0.00 and Candeias do Jamari with 0.17, that is, with a VERY BAD performance. The best IMs were Espigão D'Oeste, Pimenta Bueno, Rolim de Moura and Buritis with 1.00 with GREAT performance. However, 9 municipalities had their MI between 0.5 and 0.66, i.e., 42.86% have a REGULAR performance condition, which if added to the 28% already mentioned, creates a precarious scenario regarding investment in people. Again, the IGE had a REGULAR performance with 0.57. It is necessary to develop and create policies in the state of Rondônia and work together with municipalities on the importance of investing in people development.

The cleaning services provided by the municipalities are financed by the collection rates carried out in more than 76% together with the IPTU, according to data collected in chart 12 above. Thus, understanding how these values are managed and monitored was one of the points evaluated by the MSW managers, considering the following aspects: financial control of fees, rationalization and reduction of costs, search for increased collection, application of resources through other financing and monitoring through management reports.

Thus, 4 municipalities such as Guajará Mirim, Ouro Preto, São Francisco and São Miguel had MI equal to 0 (zero) and another two such as Candeias do Jamari and Cujubim with MI of 0.16, indicating a VERY POOR performance. Another 11 municipalities had a Municipal Index between 0.33 and 0.66, indicating a performance between POOR and REGULAR, so that of the 21 cities, 17 or 80.95% have a performance below average when it comes to aspects related to financial management and cost. A worrisome result, as it is an important part of municipal management strategies, knowing how much is collected, how to apply the resource, where and how it will be done, has a positive and substantial effect on cities. Only the municipalities of Ji-Paraná, Pimenta Bueno and Vilhena had MI with EXCELLENT performance, between 1.00 and 0.91. The state's result was 0.43, which denotes a BAD GIE for Rondônia.

According to Monteiro (2001), recycling generates jobs, income and reduces the amount of waste that can be disposed of in the soil and in landfills, all of which can be considered an alternative choice of treatment for garbage. Thus, the stimulus to the creation or development of waste pickers' cooperatives not only generates income for families, but also reduces costs for the municipal government itself, since it reduces the amount of tons sent to landfills, reducing the amount paid, especially to outsourced companies that give the proper destination to the waste. WEETMAN (2019)

Thus, with MI 0.00 or VERY BAD are the cities of Guajará Mirim, Cadeia do Jamari, Machadinho D'Oeste and São Miguel do Guaporé, another 9 municipalities had MI between 0.3 and 0.6, being between BAD or REGULAR, so in these aspects it is still necessary to make many advances. However, most managers justified that at the current moment, due to COVID-19, many projects in schools were suspended since the students were in prison until the time of the interview. *homeschooling,* but even so, no work was developed in this direction in the neighborhoods either, even though most of the municipalities indicated that the MSW sector was properly installed within the Department of the Environment.

The best indicators between 1.00 and 0.80 were for the cities of Espigão D'Oeste, Ji-Paraná and Jaru, with performance between EXCELLENT and GOOD. The GIE in Rondônia was 0.56 or REGULAR. In article 19 of the PNRS, Law 12.305/2010, item X of the PMIRS, it states that "environmental education programs and actions that promote the non-generation, reduction, reuse and recycling of solid waste" must be developed;" reinforcing the importance of all municipalities developing their Integrated Municipal Solid Waste Plans so that they establish real goals and can not only have access to resources that allow their applications in environmental education actions but that allow a more strategic performance of the management of MSW.

DIMENSION: PICK-UP AND TRANSPORT SYSTEM

NBR 10004/2004 classifies solid waste according to its degree of hazard, that is, according to its physical, chemical and infectious properties, as well as the possible risk to people's health and the environment. On the other hand, PNRS Law 12.305/2010 states that, for the purposes of the law, solid waste can be classified according to its origin, which can be urban solid waste, which includes domestic and urban cleaning waste, waste from commercial establishments, basic sanitation waste, industrial waste, health service waste, civil construction waste, agrosilvopastoral waste, waste from transportation services and mining waste. They can also be classified when their hazard is divided into hazardous and non-hazardous waste.

The criterion addressed sought information about studies to characterize the MSW of each municipality, it is considered important to know the conditions, volume, among others, to establish its chemical and biological composition, so that managers can plan what type of vehicle as well as

the quantity needed to meet the demand of each location. Specifying this is not only important for safety, but especially for cities that outsource collection and transportation, to be able to hire the correct number of vehicles without waste or damage to the public treasury and that adequately serve the community. Thus, 14 municipalities had a MI equal to 0.00, which leads to the assumption that they do not have any study to qualify their urban solid waste, a worrying fact, as it is an important indicator that could provide subsidies for an adequate planning to the municipality, both in terms of the number of vehicles needed for transport as well as the qualification due to the risk of contamination of the soil and people.

The fact is that, adding the MI between 0.00 and 0.2, which configures a TERRIBLE performance in relation to this criterion, having a representativeness of 80.95% among those who do not know the type of MSW they carry. Only the municipalities of Pimenta Bueno and Nova Mamoré had a MI of 0.75 considered GOOD. The IGE was 0.14, indicating a VERY POOR performance for the state of Rondônia, considering that in the State Solid Waste Plan, the state must have a diagnosis that includes the identification of the main waste streams in the state and their socioeconomic and environmental impacts. PNRS (2010)

An analysis of the system of collection and transportation of household waste was proposed to the managers, which are basically those produced in the residence of each family. The following aspects were considered: study on the choice and types of collection vehicles, amount of equipment, optimization of collection routes and use of software, frequencies and schedules, determination of volume and weight and the scope of collection within each municipality.

Thus, in the first analysis, the municipalities of Guajará-Mirim, Jaru, and São Miguel do Guaporé, did not score, with a MI equal to 0.00, two more, such as Candeias do Jamari and Nova Brasilândia D'Oeste, presented MI of 0.11 and 0.27, respectively, giving them a VERY BAD performance classification. Another 12 had MI between 0.33 and 0.61, which indicates a performance between POOR and FAIR. The system of collection and transportation of domestic waste is considered the most basic and also necessary activity of urban solid waste management, 15 out of the 21 cities presented inadequate conditions and low performance according to the evaluations of the managers themselves, the inefficient management can lead to dissatisfaction of the consumer who pays taxes to have this service, It can be seen that they are made available to the community, but they are not managed, because for the vast majority there are no studies that serve as metrics. The highest MI were in the cities of Pimenta Bueno with 0.83, Ji-Paraná with 0.77, Ariquemes and Porto Velho with 0.72, indicating a GOOD performance. The IGE was 0.46, that is, BAD for the general panorama of the State of Rondônia.

The next analysis on solid health waste (HSW), which also has characteristics regarding its hazardousness due to the risk of contamination it can represent, they come from hospital and

laboratory activities and cannot under any circumstances be discarded as household waste, requiring an adequate container, safe handling and proper transportation. All municipalities outsource in the state of Rondônia the collection and transportation of this type of material and collect it only in their laboratories and public hospitals, they do not do it in private companies considered generators, since these are the ones that are required by Law 12.305/2010 to give the proper destination to the RSS as defined in regulation or in rules established by the Sisnama and SNVS bodies.

The system of collection of health services as explained above is not executed by the municipalities, but they are inspected and have teams to investigate complaints of inadequate disposal when they occur, which if proven are notified and fined, so most of the municipalities had their aspects analyzed with MI equal to 1.00 considered an OPTIMAL performance indicator, with the exception of São Miguel do Guaporé, which obtained 0.87. The state's IGE was 0.99, a result considered EXCELLENT for Rondônia.

Another aspect analyzed within the dimension of collection and transportation system is the collection system from civil construction, which is derived from the waste produced by constructions and renovations of both companies and individuals. This is an activity within the solid waste sector that is poorly developed and it may be possible to say that it is not considered a priority within solid waste management in the municipalities of Rondônia. It can be seen that according to the interviewees, 15 municipalities have MI from 0.00 to 0.4, denoting a performance indicator between VERY BAD and BAD, with emphasis on two municipalities, Guajará-Mirim and São Miguel do Guaporé, which did not score in any aspect, getting 0.00. The best IMs were from the city of Cacoal and Ariquemes, with 0.7 having a GOOD performance. The IGE for Rondônia was 0.4, considered to have a POOR performance for the state.

The municipalities of Guajará Mirim, Candeias do Jamari, Cacoal, Ouro Preto D'Oeste, Jaru, Buritis, Machadinho D'Oeste and São Miguel do Guaporé had MI equal to 0.00, that is, they do not have a collection and transport system, do not carry out any control and inspection action and also do not have solutions for this type of disposal to the population, others in similar conditions are the cities of Alto Paraíso, Pimenta Bueno and Vilhena, despite having scored, still have a TERRIBLE performance indicator. The best IM went to the city of Porto Velho, with 0.87, a result considered GOOD.

However, there is little management in this aspect, the incentive of both waste pickers' cooperatives as well as scrap dealers could be a benefit for both parties, since it generates income for these workers, brings a solution to the MSW sector and the population that needs to dispose of this material. In Section II Shared Responsibility PNRS Law 12.305/2012 in art. 30 "Shared responsibility for the life cycle of products is instituted, to be implemented in an individualized and chained manner, covering manufacturers, importers, distributors and traders, consumers and holders

of public urban cleaning and solid waste management services, according to the attributions and procedures provided for in this section." Still, the CONAMA No. 416/2009 provides for the prevention of environmental degradation caused by scrap tires and their environmentally appropriate disposal. The IGE of the state of Rondônia was 0.29, indicating a TERRIBLE performance.

Almost no municipality has an adequate system for collecting this type of material and only 7 of them, such as Espigão D'Oeste, Ji-Paraná, Pimenta Bueno, Rolim de Moura, Ariquemes, São Francisco, Porto Velho and Vilhena, have recycling bins. Thus, 13 cities had MI equal to 0.00, indicating VERY POOR performance in this regard, with the best result being 0.75 for Ji-Paraná and Porto Velho considered GOOD. The state's IGE was 0.29, which is considered VERY POOR.

In order to carry out the tasks related to the collection and transportation system, it is necessary that the municipal solid waste management is properly equipped with vehicles, equipment and all other resources for such activity. In the survey, only the municipalities of Guajará-Mirim, Rolim de Moura, Ariquemes, Machadinho D'Oeste and Vilhena did not score, getting 0.00 having a TERRIBLE performance, however it is important to point out that Rolim de Moura and Vilhena, do it outsourced, however, it still generates a loss not to have a place for maintenance because the vehicles can be stopped for a period, If you don't have the budget for the repair or even, you need to wait for the pricing process to solve the equipment problem. In a general context, most of them had a performance that oscillated between REGULAR and EXCELLENT. The state's IGE was 0.6, indicating a REGULAR performance for Rondônia.

It is noteworthy that almost no municipality makes use of any type of indicator, 17 having a score equal to 0.00, two others had 0.12 and 0.25, so 90.47% of the municipalities had VERY POOR performance in this aspect. It is understood that decisions are not based on the monitoring of any of the points evaluated, be it productivity, user satisfaction, number of user complaints or number of work accidents that may occur. Not knowing the scenario also reduces the possibility of assertiveness, management capacity, planning and organization of the sector. The municipality of Pimenta Bueno was the only one that declared to monitor all these aspects by means of indicators, being 1.00 or EXCELLENT performance. The state's IGE was 0.15, which represents a TERRIBLE result for Rondônia.

SCREENING AND TREATMENT SYSTEM DIMENSION

The Sorting and treatment system dimension addresses the aspects of selective collection, sorting plant, composting plant, civil construction recovery plant, health waste treatment plant, operational conditions of treatment and recovery plants, and support for waste pickers' and scrap metal cooperatives. In the first aspect of this dimension, information was collected on: whether the municipality has a selective collection system, whether it is carried out with the participation of

waste pickers and scrap dealers, whether there is collection of cooking oil, whether there is control of the amount collected and whether there is control of the number of cooperative waste pickers.

In article 18, item XIV of the PNRS/2010, the minimum content of the PMIRS is the incentive to "programs and actions for the participation of interested groups, especially cooperatives or other forms of association of collectors of reusable and recyclable materials formed by low-income individuals, if any." However, in the survey, it can be seen that few municipalities were able to organize or prioritize the selective collection system, where 13 had a MI of 0.00 to 0.13, having as an indicator a VERY POOR performance. Only the municipalities of Vilhena had an indicator of 1.00 or EXCELLENT, Pimenta Bueno, Ariquemes and São Francisco were 0.80 or GOOD for this aspect. In view of this, the IGE for Rondônia was 0.27, indicating a TERRIBLE performance for the state.

No municipality has any mechanism for sorting waste in the municipalities, leading to the conclusion that all waste is sent to its final destination, which can be landfills, ditches or dumps. Thus, their IM was 0.00, indicating a TERRIBLE performance. The best MIs were from Ouro Preto and Porto Velho with 0.62 having a REGULAR performance, both in the previous table indicated that they do not have selective collection, but they make investments in screening, another situation is that of Pimenta Bueno with MI 0.62. The state's IGE was 0.29, a TERRIBLE performance for Rondônia.

Regarding the composting plant and its aspects, only Pimenta Bueno and Alto Paraíso have this type of plant, with a MI equal to 0.37, considered a BAD performance. The remaining 19 cities had their MI equal to 0.00 or a VERY BAD performance indicator. The lack of management and the lack of solutions on the part of the MSW management can cause more problems to the municipality, since the fact is that this waste exists and if the population does not have an adequate place to dispose of it, it will possibly be thrown in places that are inappropriate for this waste. Many managers mentioned that when they are collected, they are disposed of on the dump grounds. The IGE for the state of Rondônia was 0.03, a VERY BAD result for the state.

In the aspect that deals with civil construction plants, no municipality indicated that it has any recovery system, despite the fact that it is a very common and common waste, even with an aggravating factor due not only to the diversity of materials, but also to the volume it generates. Thus, 100% of the cities had a MI of 0.00 in this aspect, indicating a VERY POOR performance, including the IGE of the state of Rondônia.

FINAL DESTINATION DIMENSION

The PNRS Law 12.305/2010 in Chapter II, which deals with the definitions related to urban solid waste, item XV says that "tailings: solid waste that, after exhausting all possibilities of treatment and recovery by available and economically viable technological processes, presents no

other possibility than environmentally appropriate final disposal". Thus, according to the law, only after exhausting the possibilities of recovering this waste, the waste must be sent to the appropriate final destination, that is, a place that allows its disposal according to the type of waste, in order to reduce the effects of its disposal on society and the environment as much as possible. In relation to final destination, 15 municipalities have MI between 0.2 and 0.4, establishing a performance condition that varies between VERY BAD and BAD for these cities. Thus, there is a recognition on the part of municipal managers that they still do not meet the minimum requirements of regulatory and inspection bodies, and some do not even have a license to dispose of the tailings in the place they use for final disposal. Only the tailings from the RSS were considered adequate by all cities. The highest DI were from the municipalities of Alto Paraíso, Alta Floresta D'Oeste, Cacoal, Pimenta Bueno, Ariquemes and Vilhena, which ranged from 0.8 to 0.6, with a performance between regular and good. The IGE for the state was 0.42 BAD result for the state, it is important to highlight the relevant role of the state government in the environmental licensing process, in addition to the predictability in the PNRS/2010 itself, in which the states in their state solid waste plan must contemplate studies, diagnoses and goals throughout their region, including the elimination of dumps as a final destination area for tailings, so that the poor performance of the municipalities reflects the poor performance of the State of Rondônia and requires the creation of better policies and guidelines.

Aspects related to technical studies on the final destination site, appropriate location, monitoring of impacts on groundwater and surface water. For municipalities that have a final disposal system in sanitary landfills and, in the case of Rondônia, the largest portion does so through outsourced companies with an operating license, these studies are part of the protocol for them to continue operating, with the exception of Porto Velho, which has a municipal landfill and passes with conduct adjustment, according to previous data already presented.

It is not up to the municipal managers of the MSW to carry out this type of analysis unless the landfill is under the management of the secretariat linked to the solid waste sector, in the latter case these studies must be carried out by the responsible municipality itself and presented to the competent inspection body that will give the operating license. However, managers can sue for the fact that in the case of outsourced landfills, they only have an operating license when they meet the criteria established by the state department of the environment. Thus, due to the fact that most of them dispose of their household waste in landfills, the MI of most cities was 1.00, indicating an OPTIMAL performance. However, seven had a MI between 0.00 and 0.25, indicating VERY POOR performance, as expected, as they still dispose of their destination in open dumps, so they do not carry out any type of monitoring on the impacts caused to the environment. The IGE for Rondônia was 0.65, which is considered REGULAR for the state.

According to Santaella (2014), the appropriate (desired) final destination, where there is: reuse; recycling; composting; recovery; energy use and disposal of waste in landfills. However, as already demonstrated in this study, 66.67% of the 21 municipalities surveyed use landfills as final destinations, another 14.29% use open dumps, 14.29% a combination of landfills and dumps, and 4.76% have ditches as a disposal resource for domestic waste.

The worst indices refer to the municipalities of Guajará-Mirim, Candeias do Jamari, Jaru, São Miguel and Porto Velho with MI ranging from 0.06 to 0.33, with a performance indicator classified as VERY POOR. The condition of Porto Velho is highlighted, which, despite having a landfill, the operating conditions are terrible and analogous to a dump, not being able to score in important aspects that impacted a very low MI. However, a considerable part or 14 municipalities had a MI of 0.93 considered an OPTIMAL performance. It is noticeable that, as much as the municipalities present serious flaws in relation to the previous dimensions, which aggravates the general condition of urban solid waste management in the state of Rondônia, the fact that part of its waste is disposed of in landfills considerably reduces the impacts on society and the environment.

Thus, 17 municipalities had MI between 0.00 and 0.25, indicating a VERY POOR performance for this aspect. The highest MI was 0.87 for Nova Brasilândia and 0.75 for Ariquemes was considered GOOD. The state's IGE was 0.16, considered VERY BAD for Rondônia. In general, among the 21 municipalities surveyed, only the conditions for the final disposal of domestic waste have a GOOD concept, so that MSW managers need to seek solutions for other types of waste with well-established actions that mobilize the population through environmental education programs in schools and neighborhoods and partner companies that lead to an improvement in the indicators of CCR and Special and Hazardous Waste.

CONCLUSION

The research was carried out in the State of Rondônia, belonging to the Western Amazon, Northern Region of Brazil. The main objective was to analyze solid waste plans and management in accordance with PNRS Law 12.305/2010. It was possible to perceive, through the theoretical contribution and recent studies, that Urban Solid Waste (MSW) is a problem that is still very far from being solved. There are many challenges related to waste, such as: sharp growth in the world population, exaggerated consumption, lack of consistent public policies and even lack of priority of public administrations for this issue. Solid waste in Brazil had its National Solid Waste Policy Law enacted only in 2010, although this thesis developed its research in 2021, the vast majority of Brazilian municipalities do not dispose of their waste in sanitary landfills, a considerable part still does so even in open dumps, currently banned in Brazil. The PNRS provided for the extinction of this type of final waste disposal by the year 2015, that is, five years after the enactment of the Law.

The State of Rondônia, in turn, presented a panorama very close to the reality of other Brazilian regions, both in the amount of garbage produced, where the national average according to the latest survey by Abelpre (2021) was 1,100 kg/day per person and for the state of Rondônia the average is close to 1kg. As well as the problems and difficulties in collecting, transporting and disposing of waste correctly.

According to the survey information more than 66% of the municipalities surveyed stated that they did not have any evaluation tool that could serve as a performance indicator for MSW, assuming that managers can hardly say whether there are advances, stagnation or even setbacks when it comes to urban solid waste management in the state of Rondônia.

Regarding the conditions of strategic management, collection and transportation, sorting and final disposal of MSW in each city studied, the first point was to survey the conditions of each municipality, established by the Municipal Indices (IM), the results were given according to the degree of commitment, level of investment, difficulties, knowledge and experience and structure available in each place. However, in summary, the condition and performance of the Strategic Management system of the State of Rondônia through its General State Index (IGE), the result of the average of the Municipal Indices (IM) was only 0.47, demonstrating a BAD performance for the state, that is, there is much to be done in terms of Strategy and conduction of management activities, which involve: Preparation of Solid Waste Plan, Plan Execution, Institutional Structure, Organizational Structure, Employee Training, Financial and Cost Management, Social Inclusion Policies and Environmental Education of each city, so that the IGE consequently increases and improves the classification at the state level, hence the need to have indicators and monitor them periodically.

For the Collection and Transportation System, the General State Index (IGE) was 0.39, a result that leads to a POOR performance for Rondônia. With the exception of the transportation of Health Waste, which predominantly in all the cities surveyed is carried out by outsourced companies, the other types of waste in the 21 municipalities surveyed, with special attention to the study of waste characterization, collection of household waste, construction waste, etc. bulky waste, hazardous waste collection (practically non-existent), hygiene and safety of workers and creation of performance indicators, for effective management in the transport collection system.

In the sorting system, the General State Index was 0.24, considered a VERY BAD condition or performance for Rondônia, a result that reflects the lack of adoption of measures that will directly impact the costs related to the Final Destination of each municipality, since the less investments directed to sorting plants, the more garbage is discarded or sent to landfills. Increasing the amount paid to landfills, worse than the high costs, are the amounts of waste sent to open dumps, in operation in many cities in the state of Rondônia, leading to an even greater environmental and social impact.

In addition, investments in sorting bring comfort and dignity to the population, who often dump their waste from tree pruning, construction debris and others on sidewalks and/or vacant lots, precisely because there are no places indicated by the municipalities for this purpose, and it is worth emphasizing that the population pays for the collection through taxes or fees. Another point to consider is that the absence or little investment in selective collection excludes workers, often self-employed, from improving their income, caused by the lack of a point of consolidation of waste, having to do it from door to door, rummaging through household garbage in search of recyclable material.

The last point of the research on Final Destination, that is, the final point for the waste produced by each municipality in Rondônia, which according to the PNRS/2010, should only be sent to the final destination, to that which has no possibility of use or reuse, called tailings. In the research it was possible to perceive that what reaches landfills, ditches or even dumps is an immense amount of garbage that could at some point have been transformed into other products, through recycling, if the process that started back then, with Strategic Management, collection and transport and sorting had been planned, organized, controlled for efficient execution, it would be sent as little as possible to landfills. The state's IGE for Final Destination is 0.27, denoting a VERY POOR condition or performance for the State of Rondônia. Therefore, when it comes to complying with the National Solid Waste Policy LAW 12.305/2010, the municipalities of Rondônia urgently need to organize themselves to comply with this law.

Regarding the hypotheses (a) The municipalities of the State of Rondônia - Western Amazon/Brazil in their Integrated Municipal Solid Waste Plans do not meet the local demands in waste management caused by the inefficient management of their plans was refuted, (b) The municipalities of the State of Rondônia - Western Amazon/Brazil in their Integrated Municipal Solid Waste Plans, meet the local demands in waste management in a partial way due to lack of technical knowledge was confirmed, (c) The Integrated Municipal Solid Waste Plans in the municipalities of the State of Rondônia - Western Amazon/Brazil, do not meet the guidelines established in the National Solid Waste Policy was confirmed and (d) The municipalities of the State of Rondônia - Western Amazon/Brazil in their majority do not have a solid waste management plan, so they do not comply with the PNRS Law 12.305/2010 was confirmed.

The main contribution of the research was to observe the critical points that need greater attention so that MSW managers can establish or prioritize the most urgent actions that can be solved with simpler activities, create or improve an Integrated Municipal Solid Waste Plan that meets the demands of society, developing and including cooperatives and associations of waste pickers, reducing environmental impacts and the health of the population, controlling or minimizing the municipality's costs with sanitary landfills and eliminating open dumps. In addition, through the

preparation of plans, cities can seek financial resources from the Union to be applied in the projects of each municipality.

REFERENCES

1. ABRELPE. Panorama dos Resíduos Sólidos no Brasil 2018/2019. [PanoramaAbrelpe]. Acesso em 15/01/2020.

2. Andrade, M. M. (1997). Como preparar trabalhos para cursos de pós-graduação: noções práticas. São Paulo: Atlas.

3. Aurélio, B. de H. F. (2020). Míni Aurélio: O Dicionário Da Língua Portuguesa (8ª ed.). São Paulo: Editora Maralto Edições.

4. Barroso, L. F. de L. (2013). Contribuições aos Resíduos Sólido do Estado de São Paulo. Recuperado de <www.teses.usp.br> Acesso em 05/01/2020.

5. Brasil. (2019). Constituição Federal Brasileira de 1988. (1ª ed.). Editora D.O.U. Online. (Original publicado em 25 janeiro 2019). Ebook Kindle.

6. Brasil. (2017). Lei n. 12.305, de 2 de agosto de 2010. Política Nacional de Resíduos Sólidos. (3ª ed., reimpr.). Brasília: Câmara dos Deputados, Edições Câmara. (Série legislação; n. 229 PDF).

7. Brasil. Ministério do Meio Ambiente. (2019). Contexto e principais aspectos: A problemática "resíduos sólidos". Recuperado de <www.mma.gov.br/cidades> Acesso em 06/02/2019.

8. Filho, C. R. V. da S., & Soler, F. D. (2012). Gestão de Resíduos Sólidos: o que diz a lei. São Paulo: Trevisan Editora Universitária.

9. Figueiredo, A. M. B., et al. (2014). Metodologia da pesquisa. In: _____. Pesquisa Científica e Trabalhos Acadêmicos (2ª ed. revisada). Chapecó, SC: Uceff.

10. Gerhardt, T. E., & Silveira, D. T. (2009). Métodos de pesquisa. Porto Alegre: UFRGS.

11. Gil, A. C. (2009). Como elaborar projetos de pesquisa (5ª ed.). São Paulo: Atlas.

12. Gil, A. C. (2019). Métodos e técnicas de pesquisa social (7ª ed.). São Paulo: Atlas.

13. IBAM - Instituto Brasileiro de Administração Municipal. (2015). Programa Lixão Zero: estratégias, limitações e desafios. Revista de Administração Municipal – RAM. Texto: Zveibil, V. Z.

14. IBAM. (2001). Manual de Gerenciamento Integrado de resíduos sólidos. Monteiro, J. H. P., Zveibil, V. Z. (Coord.). Rio de Janeiro: IBAM.

15. IBGE. Instutito Brasileira de Geografia e Estatística. Brasil/Rondônia. Recuperado de <www.cidades.ibge.gov.br/brasil/ro/panorama>. Acesso em 05/03/2020.

16. IBGE. (2020). IBGE divulga estimativa da população dos municípios para 2020. Agência IBGE Notícias. Recuperado de <www.agenciadenotíciasibge.gov.br> Acesso em 21/10/2021.

17. IBGE. (2021). Instituto Brasileiro de Geografia e Estatísticas. Informações Ambientais. Recuperado de <www.ibge.gov.br> Acesso em 26/10/2021.

18. IBGE. Ministério das Cidades. Município dos Estado de Rondônia. IBGE.gov.br. 2019.

19. Kauark, F., Manhõe, F. C., & Medeiros, C. H. (2010). Metodologia da pesquisa: guia prático. Itabuna: Via Litterarum.

20. Lakatos, E. M. (2018). Metodologia do trabalho científico: projetos de pesquisa/ pesquisa bibliográfica/ teses de doutorado, dissertações e mestrado, trabalho de conclusão de curso (8ª ed.). São Paulo: Atlas. (Marconi, M. A., & Lakatos, E. M.).

21. Leite, P. R. (2002). Logística Reversa: Nova área da Logistica Empresarial. Revista Tecnologista – São Paulo, Ed. Publicare.

22. Leite, P. R. (2002). Logística Reversa: a complexidade do retorno de produtos. Revista Tecnologista, São Paulo.

23. Magera, M. (2003). Os empresários do Lixo: um paradoxo da modernidade. Campinas, SP: Ed. Átomo.

24. Marchi, C. M. D. F. (2018). Gestão dos resíduos sólidos: conceitos e perspectivas de atuação. Curitiba: Appris.

25. Medeiros, J. B. (2019). Redação Científica: prática de fichamentos, resumos, resenhas (13ª ed.). São Paulo: Atlas.

26. Monteiro, J. H. P. (2006). Manual de Gestión integrada de residuos sólidos municipales em cuidades da la América Latina y el Caribe. Rio de Janeiro: IBAM.

27. MMA, Ministério do Meio Ambiente. (2012). ICLEI - Brasil Planos de gestão de resíduos sólidos: manual de orientação, apoiando a implementação da Política Nacional de Resíduos Sólidos – do Nacional ao Local. Coord. Pinto, T. de P. Brasília.

28. Neto, P. N., & Moreira, T. A. (2010). Política nacional de resíduos sólidos - reflexões a cerca do novo marco regulatório nacional. Revista Brasileira de Ciências Ambientais, 15.

29. Oliveira, S. L. de. (2002). Tratado de metodologia cientifica (2ª ed.). São Paulo: Pioneira Thomson Learning.

30. ONU. (2018). Programa das nações unidas para assentamentos humanos (ONU-HABITAT). Recuperado de <www.nacoesunidas.org> Acesso em 13/01/2020.

31. Santaella, S. T., et al. (2014). Resíduos Sólidos e a atual política ambiental brasileira. Fortaleza: UFC / LABOMAR / NAVE. (Coleção Habitat, v. 7)

32. SEBRAE-MS. (2012). Gestão de resíduos sólidos: uma oportunidade para o desenvolvimento municipal e para as micro e pequenas empresas. São Paulo: Instituto Envolverde: Ruschel & Associados.

33. Severino, A. J. (2016). Metodologia do Trabalho Científico (24ª ed. rev. e atual.). São Paulo: Cortez.

34. Silveira, R. M. da C., & Clementino, M. do L. M. (2017). Novas Regras, Velhos Entraves: o Desafio da Gestão dos Resíduos Sólidos nos municípios Brasileiros. In: XVII ENANPUR. Anais. São Paulo. 2017.

35. Tullio, L. (2019). Gestão de resíduos solídos 3 [recurso eletrônico]. Organizador Leonardo Tullio. Ponta Grossa (PR): Atena Editora. (Gestão de Resíduos Solídos; v. 3)

36. Vergara, S. C. (2010). Projetos e Relatórios de Pesquisa em Administração (12ª ed.). São Paulo: Atlas.