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Characterization of municipal solid waste in the municipality of Simão Dias (SE)

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ABSTRACT
Inadequate disposal of municipal solid waste (MSW) is a common practice in some Brazilian municipalities, raising the level of economic and socio-environmental impacts. The main objective was to characterize the MSW of the municipality of Simão Dias (SE) through field visitations. The elaboration tools were a checklist, characterization sheet, and observation evaluation matrices (GUT and SWOT). Eighty-four (84) points were identified as irregular deposit spots for these materials, of which the volume estimated was around 6,150m³. A disposal period of 3 years has been considered in the visited places, and the estimated cost was approximately R$319,234 (R$2.63/hab. year) for the withdrawal of MSW at all points. Most observations (73.8%) occurred due to the accumulation of construction waste. The main challenges were the inexistence of public policies for proper MSW management, as recommended by Federal Law 12.305/2010; lack of knowledge about the origin and quantification of MSW by the local government; lack of adequate segregation at the generating source and inefficiency of actions for selective collection. Among the opportunities that stand out, the performance of the existing cooperative and the participation in an inter-municipal consortium are the most noteworthy. The main contribution of the study was the organization of information to support municipal decision-making in this sector.

KEYWORDS: Municipal solid waste. Irregular disposal. Municipal management.

1 INTRODUCTION

Municipal solid waste (MSW) is a national challenge due to the difficulty of operationalizing services, especially when there is inefficiency in the services provided to the population. Another factor that aggravates this scenario is the recurrent practice of irregular disposal of solid waste in the urban and rural environment, which disfavors the use of public space and generates environmental and socioeconomic impacts, especially in vulnerable areas away from economic centers (BRASIL, 2020).

In rural areas, the main challenges identified in solid waste management are I) the lack of identification and quantification of waste generated; II) the location, isolation, and distancing of rural communities from the urban area; III) the absence of a conventional collective collection system associated with the irregularity in packaging, separation, and disposal, and IV) the lack or inefficiency of selective collection (BRASIL, 2019a; BRASIL, 2020).

Among the contributions of this research, there is the volumetric estimate, the location, and the condition of irregular disposal of MSW in Simão Dias (SE) to help the development of public policies and guide the management of MSW in the municipality.

For the development of this research, there was funding from the Coordination for the Improvement of Higher Education Personnel (CAPES/DS).

The main objective of this research is to characterize MSW in Simão Dias (SE). Specific objectives I) Identify irregular disposal points of MSW in the city. II) Estimate the cost and volume for removal of the MSW originating from disposal points; III) assess the resulting environmental impacts; IV) Identify the challenges and opportunities in MSW management in this location.

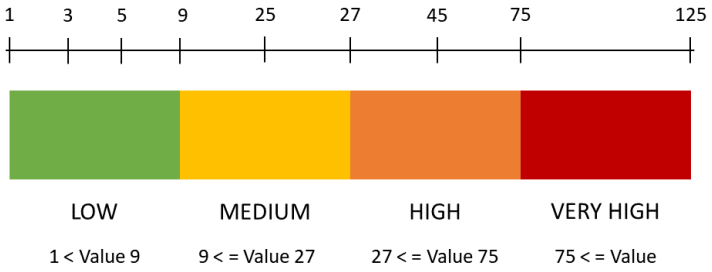
2 METHODOLOGY

Initially, a field visit occurred in November 2021 in Simão Dias (SE). As an aid, the researcher has made use of an observation registration form for the estimation of calculation, sketch, and geographic coordinates, according to the proposal by Ventura and Oliveira (2019), as observed in Table 1. Photographic records also assisted in the future analysis of observations.

The systematization and analysis of the data obtained during the visit occurred between January and April 2022. The route was based on the researchers' previous knowledge, following the urban area, then the rural area, since the municipality did not have a cadastral document of these points.

From the identification of the impacts observed at each point, the scale based on Gravity (G), Urgency (U), and Tendency (T) was used, as illustrated in Figure 1.

Figure 1 - Impact levels according to the GUT matrix



Source: Drafted by the author, based in Ventura and Oliveira (2019), 2022.

For qualitative analysis of the data, an adaptation of the SWOT matrix, conceived by Albert Humphrey between the 1960s and 1970s, was used to obtain information on strengths (S), weaknesses (W), opportunities (O), and threats (T), as recommended by GÜREL and TAT (2017). The results of this evaluation tool observed the opportunities and challenges in public management, generation, collection, transportation, treatment, and final destination of MSW.

Based on the data regarding the causes and impacts identified used the Pareto Chart, a tool developed by Joseph Juran for the area of quality management in the 1990s from the studies of economist Vilfredo Pareto, in order to make it possible to analyze and classify problems and define which one should be prioritized. The purpose of its application in the research was to identify the causes and impacts on the points visited.

3 RESULTS

3.1 Contextualization of solid waste management in Simão Dias (SE)

Simão Dias (SE) is located 132 km from Aracaju, with 40,724 inhabitants in an area of approximately 560 km² (IBGE, 2021). It is limited to the south by Pinhão and Pedra Mole, to the east by Lagarto, the main urban center in the immediate region, to the south by Riachão do Dantas, Tobias Barreto, and Poço Verde, and to Bahia (SERGIPE, 2014).

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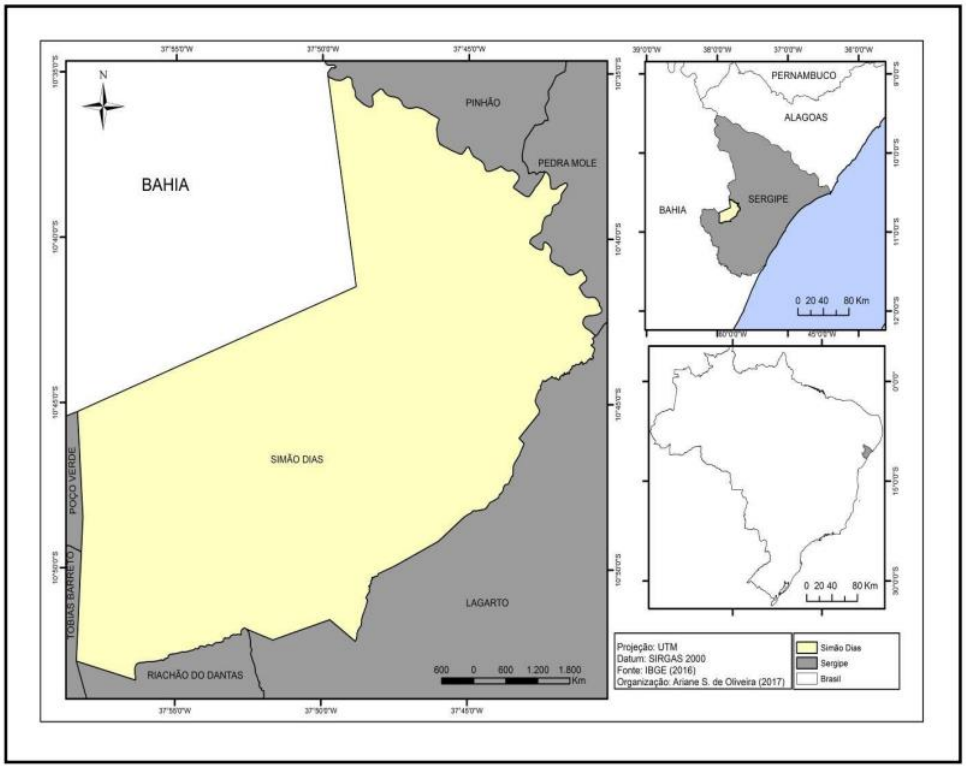
Figure 2 - Location of the municipality of Simão Dias in the state of Sergipe



Source: IBGE, 2016; Org. OLIVEIRA, 2017.

In 2010, the Municipal Human Development Index (IDHM) was 0.604, considered average, ranking 29th among the municipalities of Sergipe. About 47.3% of the inhabitants of Simão Dias live in rural areas. The economy is based on agriculture and livestock (IBGE 2010).

As for sanitation services, the municipality belongs to the Public Consortium of Solid Waste and Basic Sanitation of the South and Center-South of Sergipe (Conscensul), started in 2014, which covers 16 municipalities in the region (CONSCENSUL, 2021).

Conscensul's main area of activity since its inception is the selective collection, focusing on service and support for cooperatives of collectors and recyclable materials. The Conscensul's objective is the eradication of dumps in the consortium municipalities, because Simão Dias and the other consortium municipalities do not have a sanitary landfill (CONSCENSUL, 2021).

The Simão Dias Recyclable Material Collectors Cooperative (Coocamar) was created in a joint action by the collectors, Conscensul and Simão Dias' City Hall in 2014. The main materials collected and sold by Coocamar are paper/cardboard, glass, copper, aluminum, plastic, and metal. The objective of this cooperative is to collect recyclable or reusable urban solid waste in areas of the municipality with a selective collection system (OLIVEIRA, 2019).

In addition, there is the Selective Collection Program with Social and Economic Inclusion of Garbage Collectors and the Logistics System determined by Municipal Law No. 632/2014. Since then, the cooperative has partnered with the city council to provide services collection of dry recyclable solid waste (SIMÃO DIAS, 2014).

The City Hall declares that it does not receive federal funds for the management or infrastructure of MSW and does not have a municipal sanitation plan. There is still some contradictory information. Also, the City Hall declared that it does not belong to any inter-municipal consortium, however, it is included in the Conscensul since 2014 (BRASIL, 2019b).

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Approximately 14600 tons of USC per year are collected, and whose operation and management of USDs are carried out only by the City Hall in the amount of R$ 2.3 million per year, without the provision of service performed by a private company. Regarding the regular collection, transportation, and final destination of RSU, there is no fee (BRASIL, 2019b).

The municipality estimates that 30,000 inhabitants, equivalent to 74% of the population, are served by the direct home collection service (door-to-door). This value corresponds to 100% of the urban population (21,336 inhabitants) and 45% of the rural population (which is equivalent to 8,662 inhabitants served out of a total of 19,338 inhabitants) (BRASIL, 2019b).

All the MSW collected destined towards the dump is located 2.8 km from the urban center in an area rented by the Municipal Government, since 2014, at a monthly cost of R$ 2,500.00 (CONSCENSUL, 2014).

As for the differentiated collection of civil construction waste (CCR), the city declares that it does not have a vehicle, company, or specialized agency for this type of service. The RCC rate of the total collected was 12.33% in 2019 (BRASIL, 2019b).

3.2 Analysis of environmental impacts in the study area in Simão Dias (SE)

In total, 84 points with irregular disposal of MSW were identified in Simão Dias, and 80 (95.2%) were observed in the urban area of the municipal headquarters, the main area of concentration of these points (Area 1), as seen in Figure 3.

Figure 3 - Location of irregular MSW disposal points visited in November 2021

Source: Drafted by the author, 2022.

The 84 points were detailed, as shown in Table 1, which illustrates an extract from field observations.

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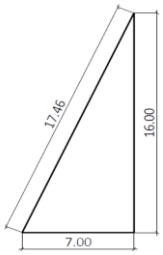
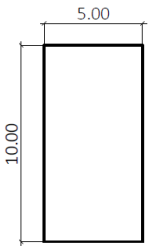
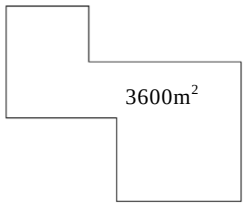
Table 1 - Registration form of the points identified with irregular disposal of MSW, in November 2021, in Simão Dias (SE)

Point	Geographic Coordinates	Photographic	Sketch	Volume
P1	10°44'23.3"S 37°48'50.9"W			V = 56 x 0,3 = 16,8 m³
P7	10°44'18.0"S 37°49'00.9"W			V = 10 x 5 x 1,5 = 75 m³
P34	10°44'16.8"S 37°48'02.7"W			V = 3600 x 1,5 = 5400 m³

Source: Drafted by the author, 2022.

Thus, the estimated value of solid waste accumulated in the 84 points was 6,143.72 m³, and in the majority, the residues were mixed, some preferably with a specific type of MSW (Table 2). The value estimate may be superior since the observation considered the MSW was visible in the locations.

Table 2 - The estimated volume of MSW in the 84 points observed in Simão Dias (SE)

	L (m)	W (m)	A (m²)	V (m³)		L (m)	W (m)	A (m²)	V (m³)		L (m)	W (m)	A (m²)	V (m³)
P1	-	-	56	16,8	**P29**	3	1	3	1,8	**P57**	12	14,5	174	87
P2	3	2	6	1,8	**P30**	3	1	3	0,6	**P58**	2,5	1,5	3,75	1,5
P3	1,5	2	3	1,2	**P31**	4,5	4,5	20,25	6	**P59**	2	4	8	8
P4	1	4	4	1,6	**P32**	3	3	9	13,5	**P60**	1,7	1	1,7	0,85
P5	1,2	2,5	3	1,2	**P33**	22	1,5	33	9,9	**P61**	2,5	2,5	6,25	1,87
P6	1	1,5	1,5	0,3	**P34**	-	-	3600	5400	**P62**	3	1,5	4,5	1,35
P7	10	5	50	75	**P35**	1	4	4	2,4	**P63**	1	1,7	1,7	0,34
P8	2	2	4	0,6	**P36**	2,5	3,2	8	3,2	**P64**	2	4	8	4
P9	7	3	21	4,2	**P37**	2	4	8	0,8	**P65**	1	0,8	0,8	0,16
P10	-	-	122,1	122,1	**P38**	1,5	2,2	3,3	0,33	**P66**	17	3,5	59,5	35,7
P11	15	5	75	22,5	**P39**	3,5	3,5	12,25	7,35	**P67**	2	4,3	8,6	4,3
P12	4	10	40	16	**P40**	5	3	15	0,5	**P68**	0,5	1	0,5	0,25
P13	11	6,5	71,5	50,05	**P41**	2	4	8	0,8	**P69**	1,2	2,5	3	1,2
P14	-	-	43	8,6	**P42**	1,5	4,5	6,75	4,72	**P70**	1	2	2	0,6
P15	4	3	12	3,6	**P43**	1,5	2	3	0,45	**P71**	2,2	4	8,8	1,76
P16	1	1	1	0,3	**P44**	1,5	3,5	5,25	5,25	**P72**	3	4	12	3,6

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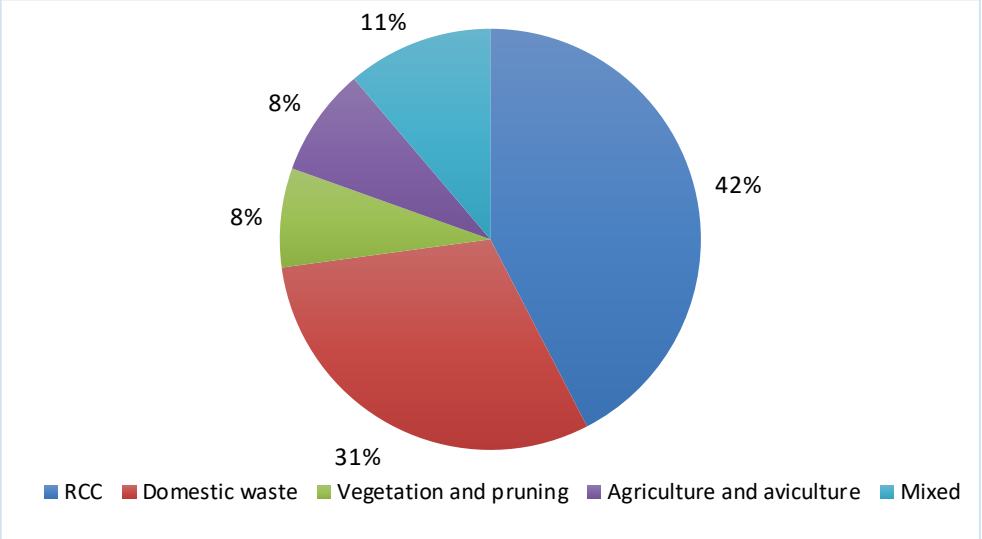
	L (m)	W (m)	A (m²)	V (m³)		L (m)	W (m)	A (m²)	V (m³)		L (m)	W (m)	A (m²)	V (m³)
P17	1,5	1,5	2,25	0,3	**P45**	2,3	3	6,9	2,76	**P73**	1,5	1,5	2,25	0,67
P18	2	20	40	8	**P46**	3	2	6	4,8	**P74**	1	2	2	0,6
P19	2	14	28	5,6	**P47**	1,5	1,5	2,25	4,8	**P75**	1,3	3,5	4,55	0,7
P20	4	4	16	4,8	**P48**	3	11	33	13,2	**P76**	1	1,3	1,3	0,2
P21	2,5	2	5	2,5	**P49**	10	1,7	17	5,1	**P77**	10	2	20	13
P22	2,5	3	7,5	3	**P50**	4	3	12	6	**P78**	1,5	1	1,5	0,45
P23	1	0,8	0,8	0,32	**P51**	3	2	6	1,8	**P79**	3	4	12	13,2
P24	2	0,6	1,2	0,48	**P52**	5	3	15	4,5	**P80**	18	2	36	36
P25	15	3	45	13,5	**P53**	2	20	40	16	**P81**	1,5	1,7	2,55	0,51
P26	3	2	6	1,3	**P54**	0,6	0,5	0,3	0,1	**P82**	-	-	173,4	17,3
P27	3	3	9	5,4	**P55**	1	3	3	1,5	**P83**	1,5	1,5	2,25	0,9
P28	5	2	10	7	**P56**	3,5	2,5	8,75	3,5	**P84**	8	2	16	8

Source: Drafted by the author, 2022.

Figure 4 shows the composition by volume (m³) and the type of waste at the 84 disposal points.

Figure 4 - Composition of the residues identified in the visited points, in November 2021, in Simão Dias (SE)



Source: Drafted by the author, 2022.

Table 3 presents the checklist of impacts observed *in loco* at some points.

Table 3 - Extract of the impacts identified in the points observed in Simão Dias (SE)

	P1	P2	P3	P4	P5	...	Pn
Impact on the environment							
Occurrence of bad smell	X		X				
Possibility of depletion of natural resources							
Proliferation of vectors							
Presence of odor and/or air pollution (burning, smoke, bird feather)							
Favoring disposal of other types of waste	X	X	X	X			
The proliferation of venomous animals							
Difficulty in performing selective collection	X		X	X			
Water pollution (slurry, unknown liquids, still water)							
Organic matter decomposition and slurry perpetration							

Deposit and/or concentration of metals and other toxic materials (dyed leather stoneware, oily and flammable substances)			X		
Damage to the landscape and surrounding area	X			X	X
Presence of toxic substances					
Impact on economy					
Maintenance cost with cleaning	X	X		X	X
Devaluation of the property					
Reduction of the use of the usable area of the property		X			
Difficulty in selling the property					
Impact on human health					
Obstruction of roads and public places		X		X	X
Threat to public health					
Damage to quality of life					
Insecurity sensation					

Source: Drafted by the author, based in Ventura and Oliveira (2019), 2021.

Based on the registration form (Chart 1) and the estimate of the volume of solid waste discarded at the points (Table 1), the cost of removing the waste identified by the type of waste was estimated, such as Construction Waste (Table 4), Domestic Waste (Table 5), Vegetation and Pruning (Table 6), Agricultural and Farm Waste (Table 7), and Mixed Waste (Table 8) and Point 34 (Table 9). Due to the dimensions of the terrain, the amount of vegetation, and the difficulty to access the site, the estimated values may be higher. In addition, there was no handling of waste on-site.

Considering the population density of Simão Dias of 72.69 inhabitants/km² (IGBE, 2021) and the 10 Km² covered in the research, there is an equivalent population of approximately 726 inhabitants in the studied area. Given the volume observed in the aforementioned points, inadequate disposal has happened for less than three years of accumulation of material, and the annual volume for the municipality (40,724 inhabitants) was calculated by one-third of the generation rate. Estimating that the inadequate disposal of residues at the observed points also occurred each year over the three years, the total volume is split into three parts.

For calculation purposes, P34 was calculated separately from the other points, for being a private lot with approximately 3,600 m² and about 5,400 m³ of inadequately accumulated solid waste.

Table 4 - Estimated costs for collection and transportation of construction waste at the analysis points in November 2021, Simão Dias (SE)

Parameter considered	Value	Estimate	Result	Unit of Income
A - Population density (inhabitant/km²)	72,69	A x B	C = 726	Inhabitant
B - Object of study (km²)	10			km²
D - Volume of observed residues (m³)	314,02	D / C	E = 0,43	m³ / hab
F - Estimated period for material accumulation (years)	3	E / F	G = 0,14	m³
H - Total population of the municipality (hab)	40.724	G x H	I = 5701,36	m³ / three years
J - Dumpster capacity (m³)	10	I / J	K = 570,13	Dumpster / three years
L - Dumpster rental for 10 days (R$) *	150	K x L	M = 85519,50	R$

*Value composed of the average price charged by the companies that provide this service (November 2021).
Analysis points of construction waste: P5, P7, P21, P26, P27, P28, P29, P32, P33, P35, P36, P37, P39, P40, P41, P42, P45, P46, P47, P48, P55, P56, P57, P58, P59, P60, P66, P67, P69, P76, P79.
Source: Drafted by the author, 2022.

The volume identified is 314.02 m³, and the total cost for the removal and collection of that construction waste from these points is R$85,519.50, which is approximately equivalent to R$ 2.10 per inhabitant every three years or R$ 0.70 per hab/year (Table 4).

Table 5 - Estimated costs for collection and transportation of domestic waste at the analysis points in November 2021, Simão Dias (SE)

Parameter considered	Value	Estimate	Result	Unit of Income
A - Population density (inhabitant/km²)	72,69	A x B	C = 726	Inhabitant
B - Object of study (km²)	10			km²
D - Volume of observed residues (m³)	225,5	D / C	E = 0,31	m³ / hab
F - Estimated period for material accumulation (years)	3	E / F	G = 0,10	m³
H - Total population of the municipality (hab)	40.724	G x H	I = 4.072,4	m³ / three years
J - Dumpster capacity (m³)	10	I / J	K = 407,24	Dumpster / three years
L - Dumpster rental for 10 days (R$)	150	K x L	M = 61086,00	R$

Analysis points of domestic waste: P9, P10, P12, P14, P18, P19, P20, P24, P30, P31, P51, P52, P53, P54, P61, P65, P68, P71, P72, P73, P74, P81, P82.
Source: Drafted by the author, 2022.

The volume identified is 225.5 m³, and the total cost for the removal and collection of domestic waste from these points is R$61,086.00, which is approximately equivalent to R$ 1.50 per inhabitant every three years or R$0.50 per hab/year (Table 5).

Table 6 - Estimated costs for collection and transport of vegetation and pruning waste at the analysis points in November 2021, Simão Dias (SE)

Parameter considered	Value	Estimate	Result	Unit of Income
A - Population density (inhabitant/km²)	72,69	A x B	C = 726	Inhabitant
B - Object of study (km²)	10			km²
D - Volume of observed residues (m³)	56,38	D / C	E = 0,07	m³ / hab
F - Estimated period for material accumulation (years)	3	E / F	G = 0,02	m³
H - Total population of the municipality (hab)	40.724	G x H	I = 814,48	m³ / three years
J - Dumpster capacity (m³)	10	I / J	K = 81,44	Dumpster / three years
L - Dumpster rental for 10 days (R$)	150	K x L	M = 12217,20	R$

Analysis points of vegetation residues and pruning: P2, P38, P44, P77, P80.
Source: Drafted by the author, 2022.

The volume identified is 56.38 m³, and the total cost for the removal and collection of vegetation residues and pruning from these points is R$12,217.20, which is approximately equivalent to R$0.30 per inhabitant every three years or R$0.10 per hab/year (Table 6).

Table 7 - Estimated costs for collection and transport of agricultural and farm waste at the analysis points in November 2021, Simão Dias (SE)

Parameter considered	Value	Estimate	Result	Unit of Income
A - Population density (inhabitant/km²)	72,69	A x B	C = 726	Inhabitant
B - Object of study (km²)	10			km²
D - Volume of observed residues (m³)	61,65	D / C	E = 0,08	m³ / hab
F - Estimated period for material accumulation (years)	3	E / F	G = 0,02	m³
H - Total population of the municipality (hab)	40.724	G x H	I = 814,48	m³ / three years
J - Dumpster capacity (m³)	10	I / J	K = 81,44	Dumpster / three years
L - Dumpster rental for 10 days (R$)	150	K x L	M = 12217,20	R$

Analysis points for agricultural and farm waste: P13, P15, P84
Source: Drafted by the author, 2022.

The volume identified is 61.65 m³, and the total cost for the removal and collection of construction waste from these points is R$85,519.50, which is approximately equivalent to R$2.10 per inhabitant every three years or R$0.50 per hab/year (Table 7).

Table 8 - Estimated costs for collection and transportation of mixed waste at the analysis points in November 2021, Simão Dias (SE)

Parameter considered	Value	Estimate	Result	Unit of Income
A - Population density (inhabitant/km²)	72,69	A x B	C = 726	Inhabitant
B - Object of study (km²)	10			km²
D - Volume of observed residues (m³)	82,97	D / C	E = 1,02	m³ / hab
F - Estimated period for material accumulation (years)	3	E / F	G = 0,11	m³
H - Total population of the municipality (hab)	40.724	G x H	I = 4479,64	m³ / three years
J - Dumpster capacity (m³)	10	I / J	K = 447,96	Dumpster / three years
L - Dumpster rental for 10 days (R$)	150	K x L	M = 67194,00	R$

Analysis points for mixed residues (construction waste and domestic waste cannot be distinguished): P1, P3, P4, P6, P8, P11, P16, P17, P18, P22, P23, P25, P26, P43, P49, P50, P62, P63, P64, P70, P75, P78, P83
Source: Drafted by the author, 2022.

The volume identified is 82.97 m³, and the total cost for the removal and collection of mixed waste from these points is R$67,194.00, which is approximately equivalent to R$1.65 per inhabitant every three years or R$0.55 per inhabitant/year (Table 8).

Table 9 - Estimated costs for collection and transportation of waste from Point 34 at the analysis points in November 2021, Simão Dias (SE)

Parameter considered	Value	Estimate	Result	Unit of Income
D - Volume of observed residues (m³)	5400,00	-	-	-
J – Dumpster capacity (m³)	10	D / J	K = 540	Dumpster
L – Dumpster rental for 10 days (R$)	150	K x L	M = 81000,00	R$

Point 34
Source: Drafted by the author, 2022.

Point 34 is a private area; despite that, it receives the disposal of the entire municipality. It is possible that the disposal takes place clandestinely for the purposes of leveling the lot and later use. No manner of inspection which inhibited the practice at the site has been identified (Table 9).

The value for cleaning the volume of waste observed in the 84 points (6143.72 m³) is R$319,233.9, due to the accumulation of 3 years, this would represent approximately 2.63 reais per inhabitant/year. This value does not consider the cost of plant and/or soil recovery actions at the site. As the municipality does not have a legal instrument (fee/charge) for solid waste management in the municipality, if there were such a charge, a portion of this previously estimated resource could be withdrawn from said fee.

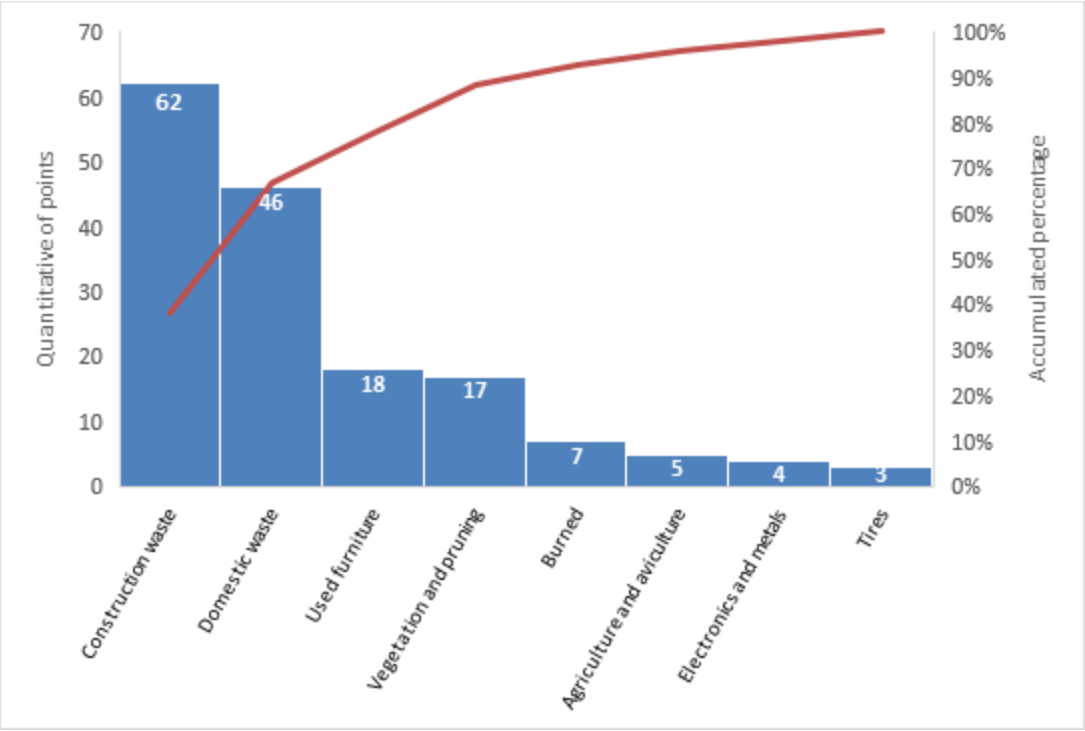
3.3 Analysis of environmental impacts in the study area in Simão Dias (SE)

The analysis was based only on environmental impacts, due of the lack of information available regarding the economy and public health impacts.

By the Pareto diagram (Figure 5), all of the 84 points (100% of the sample) show that irregular disposal occurred by the identification mostly in 62 points (73.8%) of construction

waste, followed by domestic waste in 46 points (54.7%), in 18 points (21.4%) by used furniture, 17 points (20.2 %) with vegetation and pruning.

Figure 5 - MSW obtained by the Pareto Diagram in the study area in November 2021 Simão Dias (SE)



Source: Drafted by the author, 2022.

In the 84 points analyzed, inadequate disposal comes from 67% of construction and domestic waste. Appropriate public policies such as socio-educational actions to mobilize adequate segregation can minimize the damage resulting from this. On the other hand, the public administrator can structure infrastructure for collection and transportation in a manner that is compatible with municipal demand for domestic waste. In the case of construction waste, it is possible to license areas to receive these wastes, following the requirements of environmental agencies (PINTO, GONZALES, 2005).

On the other hand, for the adequacy of the environmental health of the investigated area, it is also desirable to be attentive to the disposal of used furniture and organic matter (vegetation and pruning), which favors the reduction of 88.3% of environmental damage. In this case, campaigns scheduled annually or twice a year may contribute to this inappropriate practice and allocate the collected material to areas licensed and give the aforementioned the appropriate destination (ZANETI, 2003; ARAUJO; PIMENTEL, 2016).

3.4 Opportunities and challenges in MSW in Simão Dias (SE)

The results of the SWOT matrix are in Table 10.

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Table 10 - SWOT Matrix for analysis of the opportunities and challenges for MSW management in the municipality of Simão Dias (SE)

Stage	Opportunities	Challenges
Generation	Potential for the use of organic waste	Amount of construction waste generated in the municipality by the number of renovations and residential constructions
		There is no separation of waste by type in the generating sources
Collection	There is a selective collection of recyclable materials performed by Coocamar	Lack of a defined plan for the collection of construction waste in the municipality
		Lack of articulation plan between the work of garbage collectors and the municipal regular collection
Transportation	Easy access to rural areas	Difficulty in accessing the area where the new cooperative's headquarter is being built
Treatment and separation	Coocamar's work	Implementation of programs for segregation of solid waste, especially dry (recyclable) for donation/sale and wet (composting) for local use
	Evaluation of economic viability for construction of the composting center in partnership with the city hall, Coocamar, and volunteers	
Final destination	Conscensul's logistical support	Landfill construction
		Implementation of initiatives to encourage reverse logistics, shared management, and use of solid waste
Public administration	Participation in a public consortium for MSW	Planning actions to improve solid waste management, especially in the stages of segregation and the final destination

Source: Drafted by the author, 2022.

Generation

The technological matrix (BRASIL, 2018) indicated appropriate ways to deal with MSW: recyclable materials can return to the production chain through reverse logistics, while organic scans can be composted, for example. Thus, only the tailings should have the landfill as their final destination.

For the benefit of recyclable and organic waste, it is necessary to have proper separation at the generating source. Therefore, the use of MSW can be compromised if there is no adequate separation.

As seen throughout the research, it is common for the population to practice inadequate waste disposal, which generates an accumulation of waste throughout the city. There is an accumulation mainly of construction waste, followed by domestic waste. The presence of mixed waste at inadequate disposal points illustrates the problem.

Collection

Garbage collectors play a significant role in solid waste management. Coocamar is currently the only entity responsible for the selective collection of materials in the municipality (OLIVEIRA, 2019). The cooperative of recyclable material collectors promotes several benefits, such supply of material to the industry, reduction of municipal expenditures, and primary raw material used (WIEGO, 2009).

However, difficulty in coordinating the selective and regular collection was reported. Recyclable garbage collectors compete with regular collection employees to collect the material that residents leave on their doors. Thus, there must be agreements involving the participation of the population, Coocamar, and municipal management.

Another challenge is the lack of a defined plan for the collection of construction waste in the municipality. There are indications of what can be accomplished by the City Hall about the problem, such as preparation of a diagnosis, waste management plan, delivery points distributed throughout the urban area for small generators, and licensing of places for sorting, transshipment, and construction waste landfill (PINTO; GONZALES, 2005).

Transportation

Throughout the visited area, including the rural part, there is regular collection coverage that happens door-to-door in Simão Dias. However, no information about the rural population that isn't attended by the collection service. The environmental characteristics and morphology of the city are factors that favor access to the collection because even rural locations, albeit far from the urban center, are accessible to vehicles.

Coocamar currently operates in a rented warehouse in a location within the urban network of the city. However, the cooperative's headquarters is under construction outside the urban area of Simão Dias, on a lot provided by the City Hall. Access to the site happens through an unpaved road with a high slope. These characteristics of the road can cause difficulty in accessibility, both by pedestrians and vehicles.

Treatment and separation

As already mentioned, Coocamar plays a meaningful role in the management of MSW in Simão Dias (SE). For, the cooperative conduct the triage and sale of recyclable materials (OLIVEIRA, 2019). As selective collection is not a municipal policy, residents who know the Coocamar work make the separation of waste in their homes and contact the cooperative. That is, this process happens in a limited way. Consequently, most of the MSW produced in the municipality is thrown directly into the dump.

There is the intention that the space destined for Coocamar's warehouse will have a composting center for organic material. As organic waste accounts for a large portion of the disposal of MSW, this demonstrates a potential for composting. However, a municipal plan with guidelines involving the operation and collection of recyclable and organic waste is necessary. In addition, there also is the need for actions to ensure and engage the participation of the community.

Final destination

There are currently no conditions for the proper disposal of MSW in Simão Dias. All MSW collected is discarded in an irregular landfill. Given this scenario, one of Connscensul's goals is the eradication of dumps in the consortium municipalities (CONSCENSUL, 2014). Oliveira (2019) cites the intention of the City Hall and the Connscensul to build an area for transshipment in the municipality. Thus, the MSW would have as its final destination the landfill to be projected and built in another city.

As technical and financial difficulties are the obstacles to the project, execution, implementation, and operation of a landfill, especially in small municipalities. In this context, the legislation provides the construction possibility of small landfills, with technical simplifications within the normative parameters, besides inter-municipal consortia (ABNT, 2010).

The enforcement of initiatives to encourage reverse logistics, shared management, and the use of solid waste, as already mentioned, would reduce the cost of the operation of a future landfill, in addition to reducing the area needed to operate the landfill, causing a reduction of final tailings.

Public administration

The inter-municipal consortium is one of the instruments proposed by Brazil (2010). As seen in this research, Conscensul establishes the logistical and technical support of the management actions related to solid waste management in the municipality, such as the role played in the formation of Coocamar and continuous logistical support. In addition, in the planning which aims for the extinction of dumps in the region of the municipalities consociate.

As a challenge for the municipality, there are planning actions to improve solid waste management, especially in the steps of segregation and the final destination, identified as more problematic by the research. There may be the elaboration of a Municipal Plan for Integrated Solid Waste Management to guide the actions of the City Hall.

4 CONCLUSION

From the lack of data and information on the management of MSW, the GUT and SWOT tools can point out the conditions observed in field research regarding the scenario of solid waste in the municipality under analysis.

The main challenges are related to the irregular disposal of construction waste, as a priority, which lacks structural and structuring measures to minimize the impacts observed. This includes defining licensed areas and rules (such as maximum volume per day per person, type of construction waste received, and others) for proper disposal at voluntary delivery points.

The absence of public policies and the administrative organization of the municipality to deal with solid waste management and urban cleaning illustrate the observed scenario. Therefore, the recommendations are the following: (I) the elaboration of a municipal plan for integrated management of solid waste (PMGIRS), (II) a definition of the places for receiving various types of solid waste (voluntary delivery points), and the conditions for delivery, and (III) continuous clarification of these measures to the population.

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