CHARACTERIZATION OF URBAN SOLID WASTE AT CITY OF OBERÁ, MISIONES, ARGENTINA

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ABSTRACT

The process and results of waste characterization in Oberá, province of Misiones, Argentina, are described. The methodology used for the characterization of urban solid waste has been the one specified in the IRAM 29523:2018 standard. The samples characterized manually were selected from the representative collection vehicles for each day during the analysis period.

The research work determined the composition of the waste, which allowed to suggest useful actions for sustainable local development, based on circular economy practices and supported by an on-site characterization analysis. In this context, active strategies to reduce waste in the garbage collection vehicles are mentioned, as well as initiatives designed to encourage the reduction of the volume of waste to be disposed of in the sanitary landfill, promoting a more sustainable and efficient approach in the waste management of the municipality.

The results obtained provide useful information for decision-making in the design of strategies that contribute to incorporating circular economy practices and optimizing the collection processes.

KEY WORDS: Characterization; Composition; Circular Economy; Urban Solid Waste, Sustainability

INTRODUCTION

This research was carried out within the framework of a collaboration agreement between the Engineering School in Oberá at the National University of Misiones and the Municipality of the city of Oberá, in the province of Misiones, Argentina.

This article describes the characterization of municipal solid waste based on the national standard IRAM 29523:2018 "Municipal solid waste. Determination of composition from collection vehicles".

The city of Oberá, where the characterization work was conducted, is located in the central region of Misiones (Figure 1). It has 79.665 inhabitants (IPEC, 2024) and is the second most populous locality in the province, according to the latest 2022 census and data published by INDEC in 2023. It is known for its vibrant tourism activity, mainly due to its natural attractions such as waterfalls and cascades, and for hosting the Park of Nations, a symbolic site featuring traditional houses built by members of the migratory waves from the First and Second World Wars.

Figure1
Geographic location of the city of Oberá in the Province of Misiones, Argentina.

Note. The figure was adapted from *isondu.com.ar* and *mapas.obera.gob.ar*.

The city of Oberá is made up of 63 neighborhoods, which can be differentiated primarily by population density and the socioeconomic status of their residents.

Oberá (a name derived from the Guaraní language, translated into Spanish as "the one that shines") is a producer of black tea and yerba mate. It also has a wide variety of businesses, including wholesale and retail supermarkets, clothing stores, appliance shops, and furniture stores. In addition, the city is home to universities, clinics, and high-complexity health centers that provide services to residents from across the central region of Misiones Province.

The municipality is experiencing economic, demographic, and social growth, attracting both investors and new residents from neighboring towns.

This study presents the methodology and results that allowed the determination of the composition of Municipal Solid Waste (MSW) in the city of Oberá, Misiones, Argentina, through the manual classification of waste samples collected from municipal collection vehicles.The research was carried out under cooperative efforts between Academia and the State, aiming to strengthen local waste management strategies, support informed decision-making, and promote timely outcomes in pursuit of a more sustainable model of urban development.

DEVELOPMENT

Literature Review

Waste Management has become a challenge for municipal authorities and society as a whole, especially since the emergence of the Sustainable Development Goals (SDGs) to be achieved by 2030. In this context, the concept of the circular economy has become one of the most frequently cited terms in waste management (Bercheñi & Gonzáles Gervasoni, 2018; Lopez-Yamunaqué & Iannacone, 2023; Binte Razzak et al., 2024; Chicaiza et al., 2024; Filimonova & Birchall, 2024).

The Argentine National Strategy for the Integrated Management of Municipal Solid Waste (ENGIRSU, 2005) addresses the complexities of MSW management in urban and peri-urban areas, emphasizing the imperative to comprehensively characterize waste streams at regional and local scales. This strategy underlines the necessity of identifying waste typologies and implementing context-specific circular economy interventions—including material recovery facilities, eco-points, clean collection centers, and source-segregated collection systems—to optimize waste valorization. The plan has been operational since 2006, with a horizon extending through 2030 (Argentina.gob).

Pursuant to National Law 29516/2004, municipal authorities bear primary responsibility for the stewardship of waste generated within their jurisdictions. In response, the Municipality of Oberá has institutionalized a waste management framework since 2022, embodied in the "Oberá Sustentable" program, which operationalizes circular economy principles through targeted strategic initiatives. The empirical dataset derived from the waste characterization efforts, conducted via an Academia-State collaboration, provides robust technical-scientific evidence delineating the prevailing waste management challenges confronting Oberá. Furthermore, these findings furnish critical baseline data instrumental for the formulation of longitudinal waste management policies aligned with global sustainability targets (Marmolejo, 2010; Lopez-Yamunaqué & Iannacone, 2023; Ambaye et al., 2023).

Although extant methodologies for MSW characterization exhibit heterogeneity in sampling design and analytical precision—exemplified in foundational works by

Tchobanoglous (2002), Sakurai (2000), Marmolejo et al. (2006), Marmolejo (2010), and Hernández Rodriguez (2024)—this investigation employs the IRAM 29523:2018 standard, meticulously developed for Argentine municipalities by domain experts. Therefore, the standard takes into account the social, economic and geographic particularities of Argentina, ensuring a precise adaptation to its context for MSW characterizations to be conducted in the country.

Precedent studies applying IRAM standards to MSW characterization include those conducted in the Autonomous City of Buenos Aires (CABA) (De Luca et al., 2009; Mendoza Llamas et al., 2012), and a municipality in Córdoba (Pettigiani et al., 2013), further validating the standard's applicability across diverse Argentine urban contexts.

Methodology

The municipal solid waste (MSW) characterization work conducted in this study, along with the subsequent data analysis and dissemination of results, took place between August 2023 and April 2024.

IRAM 29523:2018, "Municipal Solid Waste. Determination of Composition from Collection Vehicle"

The Argentine national standard that enables the compositional analysis of untreated MSW. This standard is derived from the international ASTM D5231-92 (2016), "Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste."

To implement the IRAM 29523:2018 protocol and characterize waste within a municipal district, a set of initial conditions encompassing materials, resources, and other operational requirements must be met. These prerequisites are detailed in Table Nº 1.

Table 1

Required resources to apply waste characterization procedures established by the IRAM 29523:2018 Standard.

RESOURCE	DESCRIPTION
Building Infrastructure	Paved unloading area for the waste from the collection vehicles (dimensions to be determined based on the maximum collected kilograms and the collection vehicles size). Waste must not have direct contact with the ground (soil)
Machinery and Equipment	Mechanical shovel (backhoe loader)
	Collection vehicles
	Dump collection vehicles
	Front loader, rakes, brooms, and sorting table
	Mechanical or electronic scale with minimum reading of 0,001 kg and maximum capacity of 30 kg

	Electronic scale with minimum reading of 0,01 kg and minimum capacity of 100 kg
	Plastic and metal containers
	Plastic bags
	Magnet for metal detection
PPE and Others	First aid kit
	Gloves, masks, helmets, eye protection, safety footwear, and protective clothing
	At least 10 trained personnel for waste sorting by type

Note: Author's elaboration based on the procedures established by IRAM.

The IRAM 29523:2018 standard specifies and regulates the required materials and methodologies (resources) essential for MSW characterization. These include a designated area preventing direct contact of waste with the ground, precision weighing scales, and the mandatory use of Personal Protective Equipment (PPE) by personnel performing manual sorting operations.

To effectively implement the on-site characterization process in accordance with the standard, two preparatory stages were defined to ensure proper execution prior to sampling waste collection vehicles. These stages are outlined as follows:

Stage 1: Review and Consensus on Field Characterization Activities

Prior to commencing the characterization, the Faculty of Engineering team (UNaM) conducted a comprehensive literature review at both provincial and national levels to compile relevant information and best practices in MSW characterization, as well as to identify the applicable regulatory framework.

Following this, coordination meetings between the university and municipal authorities were held to establish the timeline and confirm the application of the selected standard for MSW characterization. Subsequently, the necessary conditions and resources, as detailed in Table 1, were secured to support the field activities.

Stage 2: Data Collection and Sampling Planning

According to IRAM 29523:2018, the study population comprises all waste unloading's from the collection vehicle(s) during the entire sampling period, which must cover at least one week. Regarding sampling, the standard specifies that "waste unloaded from collection vehicles shall be randomly selected each day throughout the sampling period, according to the scope of the study to be conducted." Therefore, in this study, the most representative collection vehicles were identified (those covering multiple neighborhoods), and samples were taken from these collection vehicles to determine the waste composition.

The selection of collection vehicles for sampling was performed collaboratively by university interns, municipal social service personnel, and the municipal collection service staff. These collaborators provided cadastral maps, collection vehicles routes, weight data per load and route, socioeconomic status of the population, age range, population density, concentration of commercial establishments and educational institutions, location of effluents, and other relevant criteria characterizing city zones that influence waste generation and collection.

The standard establishes that the number of primary samples (n) to be classified during the sampling period is determined based on the components under consideration and the desired confidence level (90 % or 95 %). The formula for calculating the sample size n is provided in Equation 1.

$$n = \left(\frac{t*.s}{e*x}\right)^2 \qquad \text{(Equation 1)}$$

Donde: "t*" de Student correspondiente a nivel de confianza deseado (Table N° 2); s: desvío estándar estimado; e: nivel de precisión deseado expresado como fracción; x: la media.

La Table N° 2 presenta los valores de t* para diferente cantidad de muestras n, como así también para una muestra infinita con los porcentajes de confianza.

Where:t* is the Student's t-value corresponding to the desired confidence level (Table N° 2); s: is the estimated standard deviation; e: is the desired precision level expressed as a fraction; x: is the mean value.Table Nº 2 presents the values of t* for different sample sizes (n), as well as for an infinite sample size, along with the corresponding confidence percents.

Table 2

Statistical values of t*(confidence intervals)

Quantity of samples (n)	90 %	95 %
2	6,314	12,706
3	2,92	4,303
4	2,353	3,182
5	2,132	2,776
6	2,015	2,571
7	1,943	2,447
8	1,895	2,365
9	1,860	2,306
…	…	…
Para un n ∞	1,645	1,96

Note: Summarized table extracted from IRAM Standard 29523:2018.

The values of “x” mean and “s” standard deviation are data established by the standard and obtained from specific experimental characterizations (Table N° 3).

Table 3

Statistical values of “x” mean and “s” standard deviation for each

Components	**Mean**	**Standard Deviation**
Paper and paperboard	0,24104	004662
Newspapers and magazines	0,08142	0,03029
...	…	…
Food waste	0,33390	0,05152
Miscellaneous	0,05870	0,02577

Note: This is a partial table, extracted from IRAM 29523:2018, used for explanatory purposes within the methodology.

When a municipality undertakes a waste characterization study without prior knowledge of the predominant waste component, the standard recommends using tabulated values from previously conducted studies, provided in an annex. In such cases, it is possible to review previous characterizations and select the locality that most closely resembles the target area in order to identify the representative component and, from there, initiate the sample size calculation.

To calculate the number of samples (n') based on the selected parameters (component, confidence level, and precision), the following steps must be followed:

Step 1: Select the value of t* from Table Nº 1 for n = ∞ and the chosen confidence level (e.g., 95%). Since the required number of samples to be sorted under a single set of conditions (precision and confidence) may vary depending on the waste component, a compromise solution must be applied to the main equation. For this purpose, a reference component is selected according to the study objectives.

Step 2: Once the reference component is selected from Table Nº 3 (along with its corresponding x and s values), the number of samples (n) is calculated using Equation 1.

Step 3: After obtaining n, an iteration process begins: return to Table Nº 2 and select the corresponding t-value (t_0*) for n_0. Recalculate the number of samples (n') using the newly selected t_0*.

Step 4: Compare n_0 with the new estimate n', calculated for the reference component. If the values differ by more than 10 %, repeat the calculation using n' as the new n_0. If, on the other hand, the difference between n and n' is within 10 %, select the larger value as the final number of samples to be classified, and the iterative process concludes.

If the calculated number of samples (n) is equal to N (the population), then all waste unloadings during the selected period must be analyzed.

If the number of calculated samples (n) is equal to N (population), all the samples of the selected period must be analyzed.

Results

After the resources and conditions were gathered (Table N° 1), the number of samples needed was calculated by defining the following parameters:

- Organic waste, specifically “food waste” was selected as the reference component (Table N° 3)
- The confidence level used: 95 %
- The desired precision: 10 %

Therefore:

- Deviation (s) = 0,05152 (Extracted from Table N° 3)
- Mean (x) = 0,33390 (Table N° 3)
- Precision (e) = 0,10
- t* (n= infinity) = 1,96 (Table N° 2)

Replacing the data in the main Equation:

$$n = \left(\frac{1{,}96 * 0{,}05152}{0{,}1 * 0{,}33390}\right)^2 = 9{,}15$$

Approximating the value n_0= 9.15 corresponds to the value above n=10, the difference between n_0 and n, yields a sampling error greater than 10 %, therefore, we proceed to iterate. For a value of n-1=9, the value of t* is sought in Table N° 2:

t*95(n-1=9) = 2.306, so:

$$n(9) = \left(\frac{2{,}306 * 0{,}05152}{0{,}1 * 0{,}33390}\right)^2 = 12{,}66 = 13$$

La diferencia de n (12,66) y n´ (13) es más del 10 %. Se vuelve a iterar para n-1 = 12.

t^*_{95}(n-1=12) = 2,201. Luego se realiza otra iteración hasta obtener que n =12.

The standard establishes that the minimum period to carry out the study is one week, with k being the number of days to be taken into account in determining the number of collection vehicles to be sampled. Therefore, the period selected was k= 8 days. With this data, the number of collection vehicles needed for the study was determined (Equation 2), resulting in:

$$\frac{n}{k} = \frac{12}{8} = 1{,}5\ vehicles\ required \quad \text{(Equation 2)}$$

After the number of vehicles to be sampled and the most representative collection vehicles for each day were determined (Table Nº 4), the on-site characterization of the waste was carried out.

Table 4

Results of the selection of the most representative collection vehicles for each day of characterization.

Day of characterization	Code of collection vehicle	Number of neighborhoods served
Day1	12062	9
Day2	9907	5
Day3	12062	9
Day4	v4	8
Day5	1132	8
Day6	12920	5
Day7	v3	4
Day8	11333	6

Note: The table was prepared by the authors based on data gathered during the research project.

Procedure for Determining Waste Composition On-site Using Samples from Collection vehicles

In the city of Oberá, three daily waste collection routes are carried out, covering different neighborhoods. Based on the analysis period, the estimated number of collection vehicles required for sampling was 1,5. However, due to unforeseen technical issues unrelated to the research team, the number of active routes was temporarily reduced. As a result, it was decided to characterize the waste from the most representative collection vehicles each day (Table Nº 4).

To identify the most representative collection vehicles, the research team conducted a hierarchical analysis, jointly developed with university staff and municipal agents, considering several defined approaches.

Before unloading, information about the collection vehicle was recorded, including license plate, route, date, time of arrival, vehicle weight, and driver details. Each day, the selected collection vehicles deposited its waste load at the designated study site, located away from the urban area. The collected waste was manually mixed using shovels and then divided into four parts, each subdivided again into four equal parts, and so on. This procedure—known as quartering—was followed until a partial sample weighing approximately 90 to 150 kg was obtained, in accordance with the IRAM standard.

Once the appropriate sample weight was achieved, the waste was manually sorted by type.

It is important to note that the waste from the collection vehicles was unloaded onto a leveled, isolated area—separate from routine operations—to facilitate smooth dumping, manual sorting, and weighing. The following IRAM standard conditions were met during the characterization process:

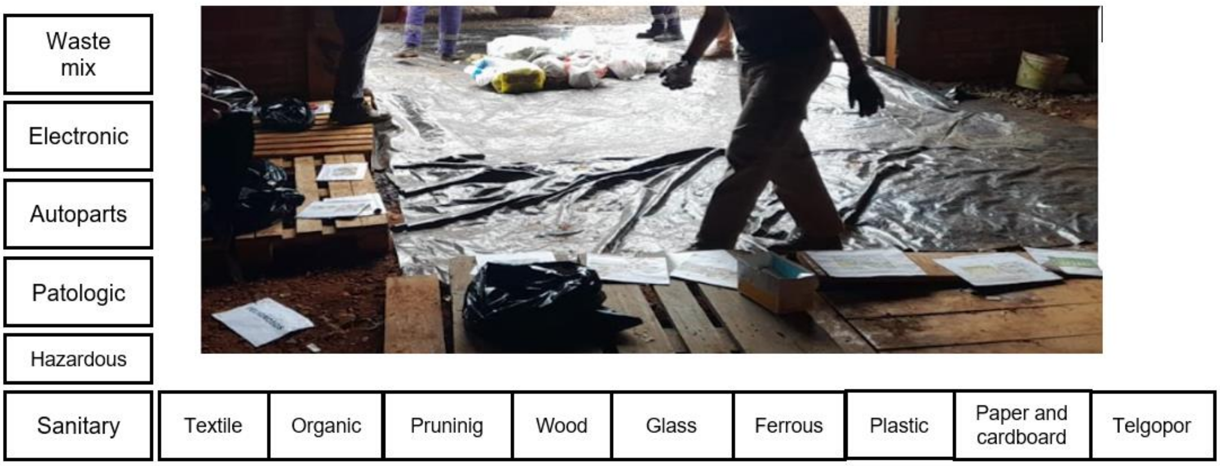
- The surface onto which the waste was unloaded was made of impermeable material, preventing direct contact with the ground.
- After each unloading, manual sorting, and weighing session, the work area was cleaned and organized to be ready for use the next day.
- No sampling was conducted on rainy days.

To ensure efficient space management and accurate manual sorting, a container layout was designed, allocating one container or bag for each waste type within a 5-meter-wide by 7-meter-long area. This layout (Figure 2) remained consistent throughout the sampling days. Each container was labeled, and the bags with sorted waste were tagged for subsequent weighing.

On the first day of sorting, the classification team received instructions on the types of waste and the designated container locations, based on the layout shown in Figure 2.

Figure 2

Arrangement of containers for the manual classification of Municipal Solid Waste



Note: The figure is my own, with an image of the work carried out on site.

Experience indicates that it is of utmost importance to keep the location of the waste containers unchanged from day to day, as this is a factor that contributes to speeding up the sorting process (Figure 3).

Figure 3

Manual classification of municipal solid waste in Oberá, Misiones, Argentina.

Note: The image is from our authors' own source

Once the manual sorting of all the waste in the daily sample was completed, each bag containing material of a single type was weighed (Figure 4) and the weight of each MSW component was recorded.

Figure 4

Manual classification of the separated waste

Note: The image is from our authors' own source

Before proceeding with weighing, it is important to make sure that the balance to be used is correctly calibrated, and the following precautions were taken:

- The balance was located on a clean area. The level of the balance was adjusted by determining the correct operation with a reference standard.
- If it was detected that the readings were different from the calibration readings, the necessary corrective actions were taken until calibration was achieved for weighing each type of waste.

The process of unloading, sampling and manual classification was repeated for 8 consecutive days. In the analysis of the data, those corresponding to the first day of characterization were discarded because they showed discrepancies with respect to the others. Therefore, Table N° 5 presents data from 7 days of characterization.

Table 5

The most significant types of MSW, results of the characterization process

	Type of waste	Quantity in (kg)	Total (kg per day)
Day 1	Pruning	37,823	125,864
	Plastics	22,051	
	Organics	17,915	
	Sanitary	15,156	
Day 2	Organics	32,105	106,732
	Pruning	16,315	
	Paper and cardboard	13,151	
	Plastics	12,441	
Day 3	Organics	78,791	153,970
	Paper and cardboard	23,605	
	Sanitary	16,645	
	Plastics	13,391	
	Type of waste	**Quantity in (kg)**	**Total (kg per day)**
Day 4	Organics	34,081	115,495
	Waste mix	17,401	
	Sanitary	15,301	
	Plastics	14,891	
Day 5	Organics	63,051	117,361
	Sanitary	13,061	
	Paper and cardboard	8,321	
	Plastics	7,551	
Day 6	Organics	26,572	130,425
	Waste mix	25,201	
	Pruning	19,201	
	Sanitary	18,255	
Day 7	Organics	23,227	110,817
	Textile	22,821	
	Paper and Cardboard	15,961	
	Sanitary	11,601	
Total			860,664

Note: The table was prepared by the company with data from the research carried out.

It should be noted that Table Nº 5 does not present data for the 8 days, because the first day was part of a test and training of the people involved in manual sorting, where sometimes mixed materials were found in the bags (individual waste type containers), due to the inexperience of the process. Considering the characterization of that day, it could provide inaccurate weights for each sorted component. The total manually sorted waste for 7 days totaled 860,664 kg. On "day 3" the largest amount was sorted, totaling 153,972 kg; while the day with the smallest amount of waste was "day 2" with 106,732 kg. The difference in weight is directly related to the number of organics (Table Nº 5), since day 3 had a greater amount, which influences the weight due to the humidity they have. It can be seen that the waste mostly present in the collection vehicles is organic waste (food remains and other quickly putrefiable waste), followed by pruning and gardening waste (grass, leaves, branches and weeds), sanitary waste (diapers, towels and toilet paper) and plastic waste. Based on the data shown in Table Nº 5, a detailed analysis was carried out to determine the percent fractions for each type of waste, which is presented in Table Nº 6.

Table 6

Percent composition of the wastes characterized during 7 days

Type of waste	**Quantity in kg**	**Individual composition % of waste**
Organic	275,78	30,94 %
Pruning	111,75	15,79 %
Sanitary	96,99	10,69 %
Plastic	90,35	10,50 %
Cellulosic	89,15	10,36 %
Textile	66,67	7,75 %
Waste mix	51,28	5,96 %
Glass	49,93	5,66 %
Wood scraps	8,71	1,01 %
Others without discriminating	20,10	Menor a 1%
Total	860,70	100%

Note: The table is prepared by the authors for segregated waste, when the percent of composition in the individual characterization has been greater than 1 %.

According to the data obtained from the characterization (Table N° 6), it can be observed that nearly 50 % of the waste present in the collection vehicles consists of organic, pruning, and cellulosic waste, representing a substantial portion of compostable material. Additionally, it is evident that over 35 % is recyclable material (plastics, glass, some papers, and cardboard).

In this context, it is important to clarify that among the waste types classified according to Figure 2, some categories represent less than 1 % of the total and are therefore not individually listed by name, as they are not significant for comparative analysis. However, they are included under the “Others” category, which encompasses aluminum cans, ferrous materials, auto parts, Styrofoam, pathological waste, electronics, and hazardous waste.

The “Waste mix” category shown in Table Nº 6 refers to the fraction composed of more than one waste material that could not be separated, such as laminated packaging, polystyrene with food residues, plastics with metals, or plastics with glass.

Previous research and the referenced standard indicate that both the type and quantity of waste generated vary according to the time of year and the socioeconomic conditions of the studied population. Although the characterization in Oberá was conducted over a reasonable period (planned, agreed upon, and during non-holiday weeks), the results presented here correspond to a specific season. Therefore, it is recommended to perform characterizations during different seasons, including holiday periods, to better understand generator behavior and estimate the variation rate—ultimately allowing for a more accurate average composition of the waste generated annually in the city.

It is important to note that Table Nº 6 was developed specifically to support decision-making in Oberá’s local waste management efforts. The waste categories used do not directly follow those from Table N° 1 of the IRAM standard, which served as the basis for the study.

Discussion

The synergy created in this opportunity, to characterize the waste of Oberá, between the Academy (Faculty of Engineering of Oberá) and the State (Municipality of Oberá), facilitated the detailed observation of the characteristics and types of waste generated in households, providing a comprehensive view of the subject. It also added in cooperation for works at the provincial level, such as the circular economy report of the 2023 cycle (Niezwida & Santacruz, 2024).

Implications for urban solid waste management and comparison with other studies

The results obtained in the waste characterization of the city of Oberá showed important implications for the planning, optimization and sustainability of local urban solid waste (USW) management. The most significant fact is that almost 50 % of the waste collected corresponds to organic and pruning waste, materials that, with appropriate strategies, can be valorized through some practice, which would not only reduce the load on the landfill, but would also generate other benefits.

In addition, the fact that more than 35 % of waste is recyclable (paper, cardboard, plastics, glass and textiles) indicates an important margin for expanding programs for separation at source and differentiated collection. The city of Oberá already has eco-points and eco-collection programs, which constitutes a favorable institutional basis for strengthening these actions. This scenario coincides with data according to characterization in the municipality of Unquillo, Córdoba, which, with a population of approximately 19,000 inhabitants, showed a similar composition: 24 % of waste is marketable recyclable waste, mainly cellulosic and metallic; 50 % corresponds to Usable Organic Waste; and only 24 % requires final disposal in landfills (Pettigiani et a., 2013). These data reinforce the hypothesis that in small to medium-sized municipalities, organic recovery and recycling can become central pillars of sustainable management.

In contrast, the Autonomous City of Buenos Aires (CABA), with a larger generation, presents a more complex MSW structure, where 54 % corresponds to household waste, 14 % to sweeping waste and the remaining 33 % to bulky waste, pruning and green spaces (De Luca et al.,2009). Although the volumes are larger and require different logistics, an important proportion of potentially recoverable fractions is observed.

The results reveal the importance of sustaining a territorialized approach, i.e., adjusted to the socioeconomic and cultural particularities of the population, the available infrastructure and the seasonality of waste generation. As suggested by previous studies (González et al., 2015; Sambiasi et al., 2022; Hernández Rodríguez, 2024), successful MSW management policies must start from the technical knowledge of what is actually generated and how it varies in time and space.

Recommendations

The waste collection vehicles do more than just transport waste—it also serves as a reflection of the habits and behaviors of the community. Through its daily routes, it provides insight into how residents separate their waste, the times at which they dispose of it, and even the level of environmental awareness within each neighborhood. In this sense, waste characterization becomes a key tool, both in large cities and in smaller municipalities, for the development of evidence-based public policies.

In the case of Oberá, the data obtained from the study enable informed strategic decisions related to the improvement of collection routes, the reallocation of municipal resources, the design of composting strategies, and the strengthening of local recycling systems. Moreover, conducting MSW characterization studies during different seasons of the year can help identify variations in climate, economic activity, and population, improving the overall quality of urban planning.

The experience also showed that municipalities in Misiones rarely have the capacity to carry out waste characterizations on their own, mainly due to differing institutional structures, the absence of essential baseline data, or the lack of trained personnel. Therefore, collecting preliminary information and securing both material and human resources—as specified in Stage 1—is essential for the effective implementation of a characterization process. In smaller municipalities, this process may need to be adapted and simplified to suit basic initial conditions.

CONCLUSION

The fieldwork, data collection, and analysis conducted during the on-site characterization of municipal solid waste in the city of Oberá revealed significant findings regarding the percent composition of different waste types collected by the municipal collection vehicles. The results showed that the largest portion of these wastes consists of organic materials with composting potential, highlighting clear opportunities for more sustainable waste management practices.

The collaboration between Academia and local Government proved to be a valuable experience, as it enabled the joint collection and analysis of data essential for improving waste management strategies.

The municipality of Oberá demonstrates strong potential for sustainable local development, given that a portion of its generated waste already fits within a circular economy model that promotes more efficient and sustainable management practices, in line with the Sustainable Development Goals (SDGs).

As a future line of research and development, it is proposed to explore composting activities and evaluate the calorific value of pruning, sweeping, and gardening waste, as these represent a significant portion of the total municipal waste composition. In this regard, energy generation from waste could offer a viable and sustainable alternative, reducing reliance on non-renewable energy sources and contributing to climate change mitigation.

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