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Context and prospects for decentralized composting of Municipal Solid Waste in Brazil

Marco Aurélio Soares de Castro
PhD Professor, Unicamp, Brazil
marcocastro@ft.unicamp.br

Jacqueline Mazini Lafratta
PhD Student, Unicamp, Brazil
j044150@dac.unicamp.br

Pedro Silva Daltro Moura
Master Student, Unicamp, Brazil
p247419@dac.unicamp.br

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ABSTRACT
Factors such as urbanization contribute to the constant increase in the generation of municipal solid waste, of which the organic fraction is the most significant. Composting is a versatile and scalable alternative for managing organic waste, and European countries have been intensifying the adoption of this strategy, both centrally and decentrally. On the other hand, the management of the Organic Fraction of Municipal Solid Waste (OFMSW) in Brazil, with the exception of unsuccessful experiments with centralized composting systems, is limited to disposal in landfills or dumps, rendering recoverable organic material useless and generating significant emissions of methane, one of the main greenhouse gases. Studies addressing decentralized composting as a strategy to improve waste management are still infrequent in Brazil. In this context, this article aimed to outline an overview of the generation of OFMSW in the world and in Brazil, as well as initiatives for its proper management. Based on a literature review, it compares the management of OFMSW in Europe and Brazil, and points out perspectives from the current Brazilian regulatory framework. Then, it discusses the potential benefits and challenges in implementing and operating decentralized systems. Decentralized composting (community or domestic) is a low-cost alternative for the management of OFMSW, but requires citizen engagement, in addition to attention to the quality of the final products. Future studies should address the positive impacts and possible restrictions of this alternative in Brazilian contexts, contributing to enable its integration into the management models currently adopted in the country.

KEYWORDS: Waste management. Municipal Solid Waste. Composting.

1 INTRODUCTION

Composting consists of the decomposition of organic matter under aerobic conditions (ROMÁN et al, 2015) by different microorganisms that convert the waste into a stable, pathogen-free compound that can be used as fertilizer for plants or improve the structure and moisture retention properties of the soil (HAUG, 1993). The process can also generate a biofertilizer liquid from the natural moisture of the processed waste (MEDEIROS; LOPES, 2006). Among the elements present in waste, microorganisms use carbon as an energy source and nitrogen as a substrate for protein synthesis in biomass production (ROMÁN et al, 2015), thus, in addition to compost and biofertilizer, the main products of microbial metabolism are carbon dioxide, water, and heat (HAUG, 1993). The composting process can be carried out centrally, on a large scale, or decentralized by community or household facilities (BRUNI et al, 2020).

Various human activities, such as agriculture and water and sewage treatment, generate compostable organic waste (MASSUKADO, 2016). In the urban environment, the Organic Fraction of Municipal Solid Waste (OFMSW) stands out, generated in the preparation and consumption of food, such as vegetable, fruit and egg peels, coffee grounds and filters, as well as branches, logs, and grass generated in pruning and weeding of urban spaces (TCHOBANOGLOUS et al, 1993; MASSUKADO, 2016). OFMSW is generally the most significant fraction generated in cities around the world, and laws in several countries consider composting a more desirable practice than landfill disposal, which nevertheless remains the most adopted strategy in Brazil and in the world. The impacts of the disposal of organic waste in landfills, in addition to the evident loss of the potential for using this material, include the generation of methane, recognized as one of the main greenhouse gases (SEEG, 2022).

Despite this context, it is observed that studies on the applicability of composting via decentralized systems, which have become popular in various regions of the world, are still scarce in the country.

2 OBJECTIVES

This study aimed to draw a panorama of composting in Brazil, from the current framework of the management of the Organic Fraction of Municipal Solid Waste (OFMSW) and the regulatory frameworks of the country, drawing a parallel with legal provisions of Europe. It was also intended to point out prospects for the adoption of so-called decentralized solutions, also from the comparison of legal provisions in force and the results of initiatives in Brazil and in Europe.

3 METHODOLOGY

The study was based on a descriptive research, which collected quantitative and qualitative secondary data. The literature consulted included books, articles, laws in force in Brazil and Europe, as well as manuals, reports, diagnoses, and documents such as the most recent version of the National Solid Waste Plan (Planares).

4 RESULTS

4.1 Urbanization and generation of Municipal Solid Waste

By 2050, the world population will have an estimated growth of 40% compared to 2020, reaching approximately 10 billion people that year (UN DESA, 2019); of this total, about 80% will be living in urban areas (WILSON et al., 2015; RICCI-JÜRGENSEN et al, 2020). Maintaining the current consumption patterns of urbanized areas will imply a more intensive use of natural resources, which will lead, among other consequences, to an increase in waste generation (HOORNWEG; BHADA-TATA, 2012).

Municipal Solid Waste (MSW) is defined as the set of household waste, generated by domestic activities in urban dwellings, and urban cleaning waste, coming from services such as sweeping, pruning, weeding, and cleaning of lawns, public roads, drainage systems, and beaches (BRASIL, 2010; CEMPRE, 2018). Annual MSW generation in the world is predicted to increase by 73%, from 2.2 billion tons in 2020 to 3.88 billion tons in 2050 (KAZA; SHRIKANTH; CHAUDHARY, 2021). Lower-middle and upper-middle income countries will account for 71% of projected MSW generation by 2050 (Table 1).

Table 1 – Share in MSW generation according to the income level of the countries

Income range	Share in MSW generation (%)	
	2020	2050
Low	5	8
Lower-middle	24	33
Upper-middle	40	8
High	32	22

Source KAZA et al. (2021), adapt.

4.2 Organic Fraction of Municipal Solid Waste (OFMSW): generation and disposal in the world

Organic Fraction of Municipal Solid Waste (OFMSW), or simply ‘organic waste,’ are names given to any organic materials of plant or animal origin, such as food scraps, pruning, and garden waste (LIM et al, 2016). In 2018, the World Bank estimated the annual generation of

OFMSW in the world at 1 billion tons, corresponding to about 44% of all MSW generated (KAZA et al, 2018). With population growth and intensification of urbanization, an 80% increase in the generation of organic waste is expected by 2050 (RICCI-JÜRGENSEN et al, 2020).

The generation rate of OFMSW varies due to cultural factors, level of economic development, and consumption habits. Per capita generation rates in so-called 'developed' countries are much higher than in less economically prosperous countries (KAZA et al, 2021). Moreover, while OFMSW represents on average 30% of MSW generated in higher-income countries, being surpassed by the generation of waste such as paper and plastic, in lower-income countries OFMSW represents 50% to 60% of the total generated (WILSON et al, 2015; KAZA et al, 2018), as seen in Table 2.

Table 2 – Change in the composition of MSW by income level of countries

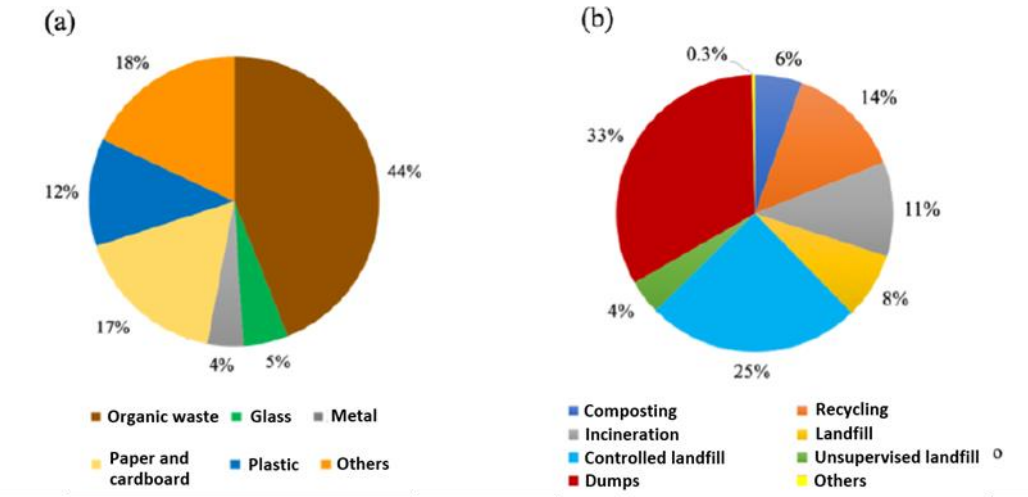
Waste	Countries income			
	Low	Lower-middle	Upper-middle	High
Organic Fraction	53 – 64%	53 – 59%	46 – 54%	28 – 34%
Glass	1 – 3%	3%	4 – 5%	5 – 7%
Metal	2 – 3%	2 – 3%	2 – 4%	5 – 6%
Plastic	6.5 – 8%	9 – 12%	11 – 12%	11 – 13%
Paper	5 – 7%	9 – 12.5%	12 – 19%	24 – 31%
Others	17 – 30%	15 – 21%	13 – 17%	17 – 20%

Sources: Hoornweg and Bhada-Tata (2012), Wilson et al (2015), Kaza et al. (2018)

A considerable portion of OFMSW is made up of the remains of food (KAZA et al., 2018). It is important to point out the difference between 'food loss,' a term that refers to the loss in the quantity or quality of food throughout the stages of production, processing, and transportation, and 'food waste,' which occur due to decisions and actions of markets, food services, and consumers, corresponding to food that has been prepared but not purchased or consumed (FAO, 2022). More than 930 million food residues were generated in the world in 2019, equivalent to 17% of the total food produced. 87% of the total comes from 'food waste,' which occurs in the consumption stage; it is emphasized that this is a behavior common to both richer and poorer countries (FORBES; QUESTED; O'CONNOR, 2021).

Regarding management alternatives, although, as already mentioned, the organic fraction corresponds to 44% of the total MSW generated annually, the amount of MSW destined for composting worldwide does not exceed 6%. Almost 60% of waste is destined for landfills, controlled landfills, and other areas of inadequate or unattended disposal (Figure 2); landfills receive one third of all MSW generated in the world (KAZA et al., 2018).

Figure 1 – Composition (a) and forms of destination (b) of MSW in the world



Source: KAZA et al. (2018), adapt.

4.3 OFMSW management in Europe

In Europe, waste management, including OFMSW, is mainly governed by Directives 1999/31/CE, 2008/98/CE, and 2018/851. The European regulatory framework is characterized by the adoption of the concept of priority, introduced by a 1975 Directive, with the first objective of minimizing the waste generated and only then managing them (EUROPEAN UNION, 1975). The concept was updated in the 2008 Directive, which applied the term 'waste hierarchy' to the sequence of prevention, preparation for reuse, recycling, other types of recovery, such as energy use, and disposal (final disposal) of waste (EUROPEAN UNION, 2008).

The current understanding is that it is necessary to transform waste management into sustainable material management to, in addition to protecting, preserve and improve environmental quality and protect human health, promote the rational and efficient use of natural resources, and promote the principles of circular economy, among other objectives (EUROPEAN UNION, 2018). In this sense, waste management must provide for recovery, which includes waste sorting, which in turn must be preceded by collection and transport (EUROPEAN UNION, 2018).

Organic waste is defined as biodegradable waste from gardens and parks, and food and kitchen waste from homes, offices, restaurants, and other food services, as well as from food processing plants (EUROPEAN UNION, 2008; 2018).

The 1999 Directive provided for successive targets to reduce the amount of organic waste sent to landfills (EUROPEAN UNION, 1999); the per capita generation of food waste must be reduced by 50% by 2030, both in retail and in households, and losses throughout the production and supply chain must also be reduced. By 2025 at least 55% by weight of urban solid waste must be recycled. The minimum percentage increases to 60% by 2030 and to 65% by 2035 (EUROPEAN UNION, 2018).

Member states of the European Union should encourage the use of OFMSW, in particular by domestic composting, and promote the use of materials produced from such waste. By December 31, 2023, they must also have the separation and use of biodegradable

waste at source, or carry out its selective collection separately from other waste (EUROPEAN UNION, 2018).

European legislation also adopts the 'proximity principle,' according to which the recovery of MSW collected from households must take place in the suitable facility closest to the generating source (EUROPEAN UNION, 2008).

The 2018 Directive also provides several examples of economic instruments and other measures to encourage the application of the waste hierarchy, such as:

- fees and restrictions on final disposal and incineration of waste, as a way of encouraging waste prevention and recycling;

- payment systems that charge waste generators on the basis of the quantity generated, and that encourage the separation at source of recyclable waste and the reduction of waste, i.e., waste considered unserviceable;

- economic incentives to regional and local authorities that promote waste prevention strategies and reinforce separate collection systems, avoiding support for disposal in landfills and incineration (EUROPEAN UNION, 2018).

4.3 OFMSW management in Brazil

The most populous and urbanized country in Latin America, Brazil accounts for almost 50% of the total MSW generated in the region (RICCI-JÜRGENSEN et al, 2020); MSW generation in the country reached 81.8 million tons in 2022 (ABRELPE, 2023). It is estimated that the organic fraction corresponds to more than 45% of the country's MSW (BRASIL, 2022), or about 36 million tons per year, equivalent to a disposal of 170 kg of organic waste per person.

Direct and indirect waste collection services serve 89.9% of the total population and 98.3% of the urban population (MDR, 2022); the average MSW collection rate in the five Brazilian regions is 92% (ABRELPE, 2019). Concerning the alternatives for the disposal of the collected waste, data from 2021 identified 5,530 units for processing, almost 90% of which were destined for MSW, according to Table 3 (MDR, 2022):

Table 3 – solid waste processing units in Brazil

type of unit	Region					Sum	%
	North	Northeast	Southeast	South	Midwest		
Sorting (shed or plant)	52	171	745	631	127	1726	31.2%
Dump	279	899	140	24	230	1572	28.4%
Landfill	16	69	323	218	43	669	12.1%
Controlled landfill	42	108	365	38	42	595	10.8%
MSW transshipment unit	5	18	119	87	20	249	4.5%
Composting unit (shed or plant)	1	8	49	15	4	77	1.4%
Branch and pruning management unit	6	7	17	25	3	58	1.0%
SUBTOTAL FOR MSW	401	1280	1758	1038	469	4946	89.4%
Units for processing other types of waste, etc.	17	123	333	87	24	584	10.6%
TOTAL	418	1403	2091	1125	493	5530	100.0%

Source: MDR (2022), adapt.

It is observed that, before a population of more than 203 million inhabitants (IBGE, 2022), the 77 composting units identified correspond to one unit for 2.8 million inhabitants. The most frequent destinations for MSW – and therefore for the organic fraction – are landfills and dumps, which, according to Table 4, are the final destination of more than 96% of the MSW collected. The recovery of waste via composting does not reach 0.6% of the total and together with recycling, accounts for just over 3% of the destination given to MSW.

Table 4 – destinations for MSW in Brazil

Type of destination	Mass (t)	%
Landfill	39,859,929.20	73.76
Dump	6,177,442.00	11.43
Controlled landfill	5,944,139.30	11.00
Recycling	1,613,786.60	2.99
Composting	304,632.30	0.56
Pruning waste management unit	142,625.10	0.26
Total	54,042,554.50	100

Source: MMA (2021)

The waste valuation fees in Brazil are inexpressive not only compared to countries such as Germany and Italy, but also to countries in Latin America and the Caribbean, such as Peru, Colombia, Cuba, and Chile (VIEIRA; SANTOS, 2023).

The final disposal of OFMSW in dumps, controlled landfills, and landfills is also related to the generation of methane (CH_4). The potential effect of CH_4 in global warming is 28 times that of carbon dioxide (CO_2), and it is estimated that it is responsible for half of the net increase in global temperature currently identified (SEEG, 2022).

The waste sector is the third largest source of methane in the world, behind only fossil fuels and the agricultural sector (UNEP and CCAC, 2021). Brazil is the fifth largest methane emitter in the world, contributing to 5.5% of the planet's methane; the waste sector is the second largest generator, emitting about 16% of the Brazilian total in 2020, surpassed only by the agricultural sector; final disposal contributes almost to 2/3 of the CH_4 emissions of the waste sector (SEEG, 2022).

Studies indicate that the mitigation of emissions in the waste sector could be achieved with low and medium-cost strategies, because they are based on already available and economically viable technologies, which would contribute to the gradual reduction of sending organic waste to landfills, and the eradication of landfills (SEEG, 2022).

4.4.1 The Brazilian experience with Sorting and Composting Plants (SCPs)

The most significant Brazilian experience with large-scale composting occurred by centralized composting systems: the so-called Sorting and Composting Plants (SCPs) were large facilities with space and infrastructure to process waste collected in one or more municipalities. Equipment and employees sort the waste, directing the OFMSW to the composting yard and the tailings to the landfill, located in the same enterprise (SIQUEIRA; ASSAD, 2015).

A widely publicized process used in several countries, including Brazil, was the Dano process, of Danish origin; the installation consisted of a cylinder rotating in low rotation, which received waste from regular collection, which was then mixed and partly broken into smaller particles; ferrous metals were later removed by magnetic separation and recyclables were manually separated (DIAZ et al, 2007).

The adoption of SCPs was stimulated in the 1980s due to a BNDES credit line that financed the purchase of these equipment by the city halls; however, in the following decade the plants were already paralyzed or deactivated. A series of factors contributed to this failure, such as the inappropriate location and lack of planning and dimensioning, resulting from the very way in which the plants were disclosed to municipal public administrators: they would be facilities capable of converting all the 'garbage' into material of high market value, becoming profitable and practically dispensing with the use of landfills (CEMPRE, 2018). The concern in the acquisition of equipment was often centered on the use of recyclable materials, disregarding OFMSW, the predominant fraction (SCHALCH et al, 2002).

In practice, the organic and recyclable materials arrived at the plant mixed and pressed, as they were collected in compactor trucks, which virtually made their separation impossible, and caused the final products to have low quality: recyclables contaminated with organics and tailings, and compost presenting a series of impurities from recyclables such as particles of glass, papers, plastics, and metals (SCHALCH et al, 2002; SIQUEIRA; ASSAD, 2015). This, in addition to the use of unskilled labor for screening and the frequent malfunctions due to lack of preventive maintenance, also caused the SCPs to be discredited and fall into disuse in the country (SCHALCH et al, 2015). Indeed, Bianco et al (2019) synthesize several studies that point out that composting carried out in SCPs without being preceded by some form of prior separation brings unsatisfactory results.

4.5 Composting: perspectives from the current Brazilian regulatory framework

Established by Federal Law 12305/10, the National Solid Waste Policy (PNRS) is based on the waste hierarchy concept of European legislation, establishing that waste management should consider, in this order, non-generation, reduction, reuse, recycling, and treatment of solid waste, and only then the final environmentally appropriate disposal of waste (BRASIL, 2010).

Article 3 (item VII) includes composting as an alternative to the final environmentally appropriate disposal of waste. PNRS assigns to municipalities the responsibility to manage household waste and urban cleaning generated in their territories; and, in its Article 36, item V, imposes on public urban cleaning and solid waste management services the duty to implement composting systems to treat the organic fraction, seeking partnerships with the community and private sector, aiming at the use and valorization of the compost produced (BRASIL, 2010).

Decree 10936/22, which regulates PNRS, establishes that selective collection systems must promote at least the separation of dry and organic waste from tailings, being subject to the goals established in the solid waste plans (BRASIL, 2022). That is, there is already a legal provision determining the collection of OFMSW separately from the other fractions, with a view to its proper recovery.

Among the instruments provided for by Law 12305/10 to achieve the objectives of PNRS, solid waste plans stand out, at national, regional, state, and municipal levels. Based on the diagnosis of waste generation and management, the plans must propose future scenarios and establish goals for reduction, reuse, recycling, among other strategies, as well as provide for programs, projects, and actions to meet these goals (BRASIL, 2010).

From the generation estimates and the management diagnosis, already commented previously, the most recent version of the National Solid Waste Plan (Planares) describes a

scenario that it calls 'realistic,' taken as a reference for the period from 2021 to 2024, which considers that the recycling of organic waste would have an initial role in reducing the volume of waste disposed of in landfills or dumps and thus in reducing costs with the final disposal. Because they have greater technical and economic viability and lower risks, composting processes would become popular among activities and services considered 'great generators': free fairs; municipal markets; maintenance services for green areas; restaurants; in addition to community initiatives (BRASIL, 2022). Over the period, in the scenario described by the plan, composting would also be carried out locally at other scales, which would also reduce costs for transporting materials over longer distances (BRASIL, 2022).

Among the planned targets is a gradual increase in the allocation of OFMSW for composting and anaerobic digestion, which should reach 13.5% of the total mass by 2040. By this year, all Brazilian cities must have some initiative to value OFMSW, such as selective collection, composting and anaerobic digestion "on a pilot or commercial scale, mechanical-biological treatment units, among others" (BRASIL, 2022).

The Planares goals related to OFMSW are basically related to reducing the amount of waste sent to landfills and increasing the recovery (recycling) rates of the organic fraction. It is intended that the reduction in sending for final disposal occurs by reducing the generation of waste and increasing the reuse of products, by the creation of food banks to avoid waste and by the access to resources to implement mechanical and biological treatment (MBT) units for organic waste (BRASIL, 2022). Therefore, the incentive to centralized composting strategies is explicit.

The increase in OFMSW recovery rates should occur by the stimulation of the compostable products market and the prioritization of the use of these raw materials, by the expansion and consolidation of the separate collection of organic waste, and by its recovery. These guidelines provide strategies such as:

- encourage separation systems at the source, placing them as a condition in the state and municipal environmental licensing process;

- encourage simplified procedure for installation of composting units and small biodigesters;

- guide the adoption of municipal laws that oblige the so-called large generators (supermarkets, fairs, restaurants, and the like) to adopt OFMSW management strategies different from the final disposal; at the same time, support municipal programs of separation at the source, composting and anaerobic digestion of organic waste from these generators;

- stimulate actions to expand the use of compost in urban green areas, including urban agriculture (BRASIL, 2022).

Finally, the plan determines that priority in accessing Union resources will be given to eligible proposals that foresee actions for social inclusion and economic emancipation of waste pickers; solutions that promote the reduction of the final disposal of waste and that enable separation at the source and selective collection of OFMSW; and systems for the recovery of organic waste, among other aspects (BRASIL, 2022).

4.5.1 Large generator laws

Still in terms of legal provisions, some of the initiatives identified throughout the research were the so-called "large generator laws." These are legal provisions that generally

establish that generators of volumes or masses of waste above previously defined values must be responsible for their collection, and the costs arising from it, and no longer dispose of waste for collection by the public Solid Waste Management Service.

One of the examples is the municipality of São Paulo, whose Decree 58701/19 defines as large quantity generators commercial and industrial establishments, service providers, entities of Indirect Administration, and state and federal agencies and entities of Direct and Indirect Administration that daily generate above 200 liters of class IIA waste (non-hazardous, non-inert) or above 50 kg of Class IIB waste ('inert'), and condominiums of non-residential or mixed-use buildings that generate a total of Class II waste equal to or greater than 1000 liters daily (SÃO PAULO, 2019). In the Federal District, Law 5610/16, later amended by Law 6484/20, defines as large quantity generators those that generate above 120 liters of non-hazardous and non-inert solid waste (comparable to household waste). It explicitly determines that large quantity generators are fully responsible – from separation to final destination – for the management of solid waste, bearing all the resulting expenses (DISTRITO FEDERAL, 2016; 2020).

The restrictions of laws such as these and the large volumes of OFMSW generated have caused many large quantity generators to adopt practices for managing this fraction, reducing the amount of waste effectively generated to use public collection services. As an example, the Italian Embassy in Brasília adopted measures such as replacing plastic cups with compostable cups and began to compost the remains of food consumed, as well as organic waste from landscaping and maintenance of the large green area on the site. As a result, the amount of waste sent daily for collection and disposal in landfill decreased from 125 kg to 2 kg (SABATINI; WANDERLEY, 2021).

4.6 Decentralized composting

To circumvent the problems arising from the processing, in centralized systems, of organic waste from regular collection, countries such as Germany and the Netherlands have encouraged the prior separation, at the source, of organic waste. This, on the other hand, increases collection and transportation costs, due to the need for specific OFMSW collection; one strategy has been to collect OFMSW once a week and the rest of the waste twice a week. The increasing costs for handling and transportation over long distances, combined with the high costs and complexity of operation of the enterprises, can make centralized composting systems unfeasible (BRUNI et al, 2020).

The potential logistical and economic challenges associated with waste collection, of quality assurance of the compost obtained in large facilities, and the context outlined by the large generator laws, among other aspects, may stimulate the adoption and implementation of decentralized systems, in which composting is carried out at various points, generally close to the sources of waste generation.

The so-called community composting centers are facilities that process organic waste from residents and producers of the same community; in certain cases, other small generators of organic waste, such as businesses and surrounding residents or visitors can also use these systems; such facilities are considered as 'at source' treatment, due to their proximity to the generators (ADHIKARI et al, 2010). Another alternative to centralized systems is home composting, in houses or even apartments, carried out in buckets or plastic boxes and processing only household waste; home composting systems, even if they do not reach

thermophilic temperatures, are capable of generating compounds that often have sufficient quality for use in gardens or vegetable gardens (VÁZQUEZ; SOTO, 2017).

The decentralized treatment of organic waste has significantly lower logistics, maintenance, and operation costs compared to centralized systems (BRUNI et al, 2020). Other potential benefits are the reduction of installation costs and greenhouse gas emissions, as well as the conditioning and fertilization of extensive agricultural areas (ADHIKARI et al, 2010).

The consulted literature analyzed recent experiences in different locations, and generally highlights the potential of decentralized composting systems, while emphasizing aspects of attention regarding the location of facilities, community organization, and products obtained. After analyzing decentralized systems in Italy, Bruni et al (2020) argue that community composting is integrable to waste management systems, especially in smaller locations, while in larger cities, decentralized facilities can support medium-sized centralized plants; however, they propose a greater focus on community composting, which may be more possible to control than domestic composting, and recommend the prior identification of the socioeconomic characteristics and specific demands of the region where decentralized systems are intended to be installed. Alves et al (2022) analyzed the location and operation of community composting centers in the Spanish region of Galicia, pointing out that initiatives such as this require a study of the municipality in which the systems will be implemented, especially regarding urban planning, population distribution, and existing green areas; they also highlight the importance of characterizing the structuring material from pruning and weeding green areas. Kohli et al (2022) analyzed compounds produced in several centers of the French city of Nantes, attesting to the potential of community composting; nevertheless, they emphasize the need to evaluate the presence of metals in the compounds, especially if produced in areas close to industrial regions. De Boni et al (2022) conclude on the environmental and socioeconomic advantages for small communities and territories to treat their organic waste in a decentralized manner, instead of sending it to large facilities, but warn about the need for active citizen involvement in the process. Indeed, efficient environmental education programs are essential to establish awareness and technical capacity in the community, providing a correct separation of waste at the source and ensuring the quality of the final result (PANARETOU et al, 2019; BRUNI et al, 2020).

In Brazil, perennial decentralized composting initiatives are still scarce. The project “Revolução dos Baldinhos” is initially mentioned, carried out in two communities of Florianópolis (SC) since 2008. It is based on the selective collection of organic waste with the distribution of buckets to homes and the installation of plastic boxes on the streets of the region, as well as door-to-door awareness work on the correct separation of waste. The project currently has 28 VDPs (Voluntary Delivery Points) that receive organic waste from the communities and two condominiums outside the area, and carries out independent collection of waste in other institutions. It serves about 2400 people monthly, receiving 12 tons of organic waste and producing 3 tons of compost (MMA et al, 2018; VIEIRA; SANTOS, 2023). It is expected that the institutionalization of the project may bring the recognition of community composting as an activity of collection, processing, and marketing of waste that can be provided by associations or cooperatives of waste pickers (MMA et al, 2018).

In turn, the project “Feiras e Jardins Sustentáveis”, started in São Paulo (SP) at the end of 2015, manages organic waste generated in free fairs in the city. Teams from the sweeping companies guide the fairgoers to separate remains of fruits, vegetables, and greens. At the end

of the fairs, cleaning agents collect and forward the material to one of the five composting yards in the city, all near free fairs. Arriving in the yard, the waste is mixed with the remains of pruning trees and straw and laid out on thresholds for about 120 days. The compost obtained is used as an input in gardens and public squares, and also distributed free of charge to the population. Together, the yards have the capacity to receive 15600 tons of material and process up to 3120 tons of organic compound in a year (SÃO PAULO, 2021).

5 CONCLUSION

The global management of OFMSW involves structuring, implementing, and maintaining a legal and regulatory system that stimulates and encourages composting initiatives at various levels.

Given the significant generation of OFMSW in Brazil, composting, consistently underprivileged in the actions taken so far in the country, is a fundamental part in improving waste management.

Although the literature attests to the potential of decentralized actions in reducing the final disposal of waste, which historically predominates in the world and in Brazil, initiatives on this scale are also infrequent in the country. In this sense, municipal laws focused on curbing the sending of waste to landfills by large quantity generators are instruments that stimulate the adoption of solutions aimed at reducing generation – the primary objective of waste management – and composting of OFMSW, especially in a decentralized manner.

Decentralized initiatives underway in Europe and Brazil signal the viability of systems at this scale, which, however, requires not only engagement and technical training of interested citizens, but also a planning effort considering the specifics of the chosen region, as well as attention to the final product and to the areas that will receive it. Finally, we still observe a great demand for specific studies on the applicability of decentralized composting initiatives in the Brazilian context, identifying the potential positive impacts and eventual restrictions and helping to determine if – and under what conditions – it would be possible to formally integrate them into the MSW management models currently established in the country.

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