Identification of barriers to reverse logistics of organic waste: a literature review considering the stakeholder Public Entities

1. INTRODUCTION

Reverse logistics has emerged as a crucial component in the sustainable management of organic solid waste, helping to mitigate the environmental impacts associated with inadequate waste disposal. Both large generators and those involved in Reverse Logistics assume competencies within the scope of responsibility, in order toensure the environmentally appropriate disposal of waste (MMA, 2019). Organic waste is mostly: biodegradable materials from plants or animals, food waste, yard waste, wood and paper products (Kazuva & Zhang, 2019) and others. And it is estimated that Brazilians generated an average of 1.04 kg of MSW per day in 2022, totaling approximately 77.1 million tons of MSW generated in the country that year (ABREMA, 2023). This corresponds to more than 211 thousand tons of waste generated per day. Inadequate management of this waste can result in greenhouse gas emissions andsanitary problems, in addition, it contributes to the proliferation of parasites and disease vectors in bodies of water (Gimenez et al., 2024). In this sense, reverse logistics is a strategy and a necessity for the disposal of organic waste.

However, there are barriers associated companies to implement a reverse logistics chain for organic waste. Among them, we can highlight the lack of adequate infrastructure (Gebreegziabher et al.2014), lack of public policies related to this purpose (Menyuka et al., 2020) and the absence of economic incentives (LUDLOW et al., 2021). In this way, it is the role of thesstok It is holders, especially public entities, such as municipal governments, for example, formulate and implement policies that promote reverse logistics, in addition to working to raise awareness and educate the population on this topic.

Therefore, this article seeks to answer the following question: what barriers to the implementation of reverse logistics for organic waste relate to the Public Entities stakeholder? To explore this issue, this work aims to identify the barriers associated with the reverse logistics of organic waste, in a literature review, considering the stakeholder Public Entities. The relevance of this study, therefore, liesnthe urgent need for sustainable solutions for organic waste management, highlighting mainly the essential role of public policies and collaboration between different stakeholders to achieve an efficient and sustainable circular economy. Understanding the barriers and strategies to overcome them, with a focus on public entities, can provide valuable insights for formulating effective policies and promoting sustainable practices in organic waste management.

2. METHODOLOGICAL PROCEDURES

A systematic review of the literature was carried out with the aim of answering the research question:What are the barriers to implementing reverse logistics for organic waste for the Public Entities stakeholder?In this way, the research was conducted following the steps of the PRISMA method (Galvão; Pansani; Harrad, 2015): identification and selection of articles,coding of articles, analysiss of the coded base and discussion of the results.

Queries to the Web of Science (WOS) and Scopus databasesto carry out the first stage. Those are the search terms: “municipal solid waste”, “urban solid waste”, “barrier”, “limitation”, “challenge”, “wet waste” and “organic waste”. The search returned 181 and 162 articles in the WOS and Scopus databases. Inclusion and exclusion criteria were applied to these results: works must be in English or Portuguese (BR), excluding conference articles, book chapter and duplicates. As a result, we obtained 220 articles in the aforementioned databases.

In the second stage, titles and abstracts were read. The 220 articles were classified into: no relevance (articles that did not addressthe topic of barriers to waste reverse logisticsorganic)up to high relevance(articles related to organic waste, reverse logistics and barriers).After this step, remained 23 articles.

Then, the third stage of coding began, where the articles were read in full to identify thes specific barriers to Public Entities. At this stage, 55 articles were excluded because they were not accessible or were not correspond to the research objective, leaving 68 articles at the base. Finally, 33/68 articles were directly related with barriers to OSW reverse logistic for the Public Entities.

3 RESULTS

To compose the database, 33 articles were selected, published between 2014 and 2023,being possible to identify14 Barriers in the literature related to Entities Public, which make it difficult to implement OSW Reverse Logistics. Such barriers are presented below in the literature review. The barriers are summarized in Table 1.

Table 1- Barriers to reverse logistics of OSW concerning Public Entities

Barriers	**References**
B1-Lack of urban planning and suitable infrastructure for waste treatment facilities	Gebreegziabher et al., (2014); Kazuva e Zhang, (2019); Bong et al., (2017); Daskal et al. (2022); Zhang, Wen e Chen, (2016); Mascarenhas et al. (2021); Mushtaq et al (2020);
B2- Difficulty in expansion due to composting areas requiring large areas of land	Menyuka, et al., (2020); Lunag, Elauria e Burguillos, (2021); Zhang,Asi Wen, Chen, (2016); Gonçalves et al. (2018)
B3- Lack of policies to support the use of organic waste	Menyuka, et al., (2020); Hettiarachchi, Meegoda, Ryu (2018); Ludlow et al (2021); Gonçalves et al., (2017); Carmen-Niño et al.(2023); Pan et al. (2015)
B4- Lack of financing and investments	Pour, Webley e Cook (2018); Zhang, Wen, Chen, (2016); Bong et al., (2017); Fereja e Chemeda, (2022); Ludlow et al (2021); Santos et al., (2018); Pandyaswargo et al., (2019); Gonçalves et al., (2018); Carmen-Niño et al.(2023);Chineme et al.(2022)
B5- Excessive bureaucracy, due to weak legislative coordination at different institutional levels	Lohri et al.(2016); Morone, Yilan e Imbert (2021)
B6- Inadequate management of organic waste (limited transport and collect, costs, handling and inadequate treatment)	Xiao et al (2020); Siqueira e Assad (2015); Carmen-Niño et al.(2023) ; Mushtaq et al., (2020); Fereja e Chemeda, (2022)
B7- Technical challenges of separation planning MSW	Pour, Webley e Cook (2018); Zhang, Wen, Chen, (2016); Gonçalves et al., (2018); Carmen-Niño et al.(2023)
B8- Availability of MSW for energy use is not sufficient to supply urban demands	Pour, Webley e Cook (2018); Pérez et al.(2022)
B9- Low technical knowledge and antipathy towards the recovery of organic MSW as an alternative energy source among stakeholders	Pour, Webley e Cook (2018); Pan et al.(2015); Sousa et al., (2021); Santos et al., (2018)
B10- Logistics costs(transportation, maintenance and retraining in new technologies)	Menyuka, et al., (2020);Perteghella et al.(2020); Carmen-Niño et al. (2023) ; Sealey e Smith (2014)

B11- Limited technical knowledge to identify and separate waste	Kazuva e Zhang (2019); Lunag, Elauria e Burguillos, (2021); Shen et al., (2015); Gonçalves et al., (2017);
B12- Lack of government cooperation in affordable financial and environmental values for investment in MSW	Kazuva e Zhang (2019); Carmen-Niño et al.(2023); Hung (2015).
B13-- Lack of supervision and monitoring of indicators in obtaining results/reports	Hettiarachchi, Meegoda, Ryu (2018); Carmen-Niño et al.(2023); Perteghella et al.(2020).
B14- Lack of measures that encourage waste recovery by interested parties	Hettiarachchi, Meegoda, Ryu (2018); Delley e Brunner (2018); Bong et al., (2017); Siqueira e Assad (2015); Khamkeo et al., (2021); Behrooznia et al., (2020); Daskal et al. (2022)

4. DISCUSSION

Based on the literature review, the Public Entities stakeholder plays a central role in the reverse OSW channel, as they range from more operational barriers such as "Limited technical knowledge for identification and separation of waste", to more tactical barriers such as "Lack of urban planning and adequate infrastructure for waste treatment facilities" to more strategic barriers such as "Excessive bureaucracy, due to weak legislative coordination at different institutional levels".

These barriers, when they exist at a certain level, strategic for example, cause chain barriers at the tactical and/or operational levels. For a territory, when waste management policies that promote the reduction or reuse of organic waste for composting purposes may compromise the availability of waste for energy use (Pour, Webley and Cook, 2018), for example. In this situation, waste management strategies (composting and energy production) are competing for the same resource, which can compromise the availability of waste for both strategies, promoting an operational barrier of unavailability or insufficient waste. In the same way, the lack of planning and adequate infrastructure for organic waste treatment installation, related to the tactical level, as biogas production units (Gebreegziabher et al., 2014; Bong et al., 2017) or composting (Kazuva and Zhang, 2019; Daskal et al., 2022); Mushtaq et al., 2020) cause the barrier, at an operational level, lack of extensive adaptive planning for separating waste at the generating source (Pour, Webley and Cook, 2018), because if there are no waste recovery units, there is no reason to separate them, much less commit generators to this task.

The literature review also showed that the focus of research is on developing countries and that despite their geographic and political differences, they share common barriers. For example, the barrier "Lack of measures that encourage the recovery of waste by interested parties", which both in Brazil (Siqueira and Assad, 2015) and in Malaysia (Bong et al., 2017) the other stakeholders in the reverse channel are penalized with the lack of encouragement and support from local governments for the development of recovery facilities. Also, the lack of government cooperation in providing financial values for MSW investments may impede the development of sustainable supply chains in Tanzania regarding composting (Kazuva and Zhang, 2019) and in Mexico regarding informal waste collection systems (Carmen-Niño et al., 2023) or even the failure to provide land to expand composting areas in China (Zhang et al., 2016). Logistical costs are also common barriers in South Africa, which faces high costs for accessing inputs and transporting organic waste for urban agriculture (Menyuka et al., 2020) as well as in Bosnia-Herzegovina and Mozambique, which face high transport costs in waste collection due to narrow and unpaved roads (Perteghella et al., 2020).

The orchestrating role of Public Entities in the reverse channel ranges from the regulatory function, through the execution and/or facilitation of RL activities as well as inspection and monitoring functions to evaluate policies and programs. The regulatory function

is the primary function, with the aim of ordering activities in the reverse channel and can manifest itself as a barrier when there is excessive bureaucracy due to weak legislative coordination, making it difficult to recover organic waste (Morone, Yilan and Imbert, 2021) or the absence of clear guidelines and frameworks to facilitate and regulate the use of organic waste in urban agriculture (MENYUKA et al., 2020). Second, as an executor, efficient management may not be used to treat organic waste due to inadequate transportation, costs, handling and treatment practices (Xiao et al., 2020; Fereja and Chemeda, 2022) and as an enabler of RL activities, not providing permissions to use land areas for composting expansion (Menyuka et al., 2020) or for waste sorting and separation facilities (Zhang et al., 2016). Third, as a supervisory and control entity to evaluate the RL activities adopted, if the RL activities are not complied with, regulations due to lack of governance and insufficient monitoring (Hettiarachchi et al., 2018), will constitute a barrier to the objectives of waste RL. Finally, Public Entities as orchestrators permeate the educational role they play over other stakeholders in the reverse channel, as, in addition to participation, community knowledge and understanding of the problem of solid waste are crucial (Khamkeo et al., 2021) as well such as the understanding that as generators, they have responsibility for waste. These educational actions need to be orchestrated by municipal authorities, as well as being welcomed by non-profit organizations.

Because barriers are possibly correlated, that is, when they occur at one level it triggers barriers at other levels (strategic, tactical or operational) and due to the functions linked to the role of orchestrator of the reverse channel, the actions emanated by Public Entities need to be integrated so that the objectives of MSW management are achieved and the results of reverse logistics are enhanced.

5 CONCLUSION

This study aimed to identify the barriers to Reverse Logistics for MSW, considering the Public Entities stakeholder in the literature. 34 articles were identified, listing 14 barriers to the aforementioned stakeholder, ranging from more strategic barriers such as “Excessive bureaucracy, due to weak legislative coordination”, passing through more tactical barriers such as “Lack of government cooperation in financial values” to more operational barriers such as “Lack of inspection and monitoring of indicators”. The possible correlation between barriers due to the functions of Public Entities (regulation; execution/enablement of RL activities; inspection and monitoring) and the occurrence of barriers between levels (strategic, tactical and operational) was also discussed.

This research contributes in the theoretical scope as there are few studies that deal with the barriers of the MSW management scenario in the regions (Huang et al., 2022) and because it is the first study that discusses in depth the barriers to OSW RL for the Public Entities stakeholder. Identifying and understanding these barriers is fundamental to theoretical advancement in the field of MSW management, providing a solid basis for future research and development in this area. It also contributes to practice, as it brings a compilation of barriers that, if identified for a given territory, can help managers address public policies and private sector actions in an integrated way to overcome such barriers and achieve the objectives of the OSW reverse channel.

As this is the first work to survey the barriers to OSW RL for Public Entities, we recognize that as it is a theoretical survey, it needs practical application to confirm these barriers. For future research, it is suggested to carry out an empirical survey with statistical analyzes to identify the importance of these barriers among experts in the field and/or with technicians from

municipal organizations responsible for OSW management. It is also suggested to carry out statistical tests (multivariate analysis) to validate the correlation between the barriers.

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