



## THE IMPORTANCE OF MONITORING ACTIONS IN REVERSE LOGISTICS: NATIONAL OVERVIEW, CETESB (SP) SUCCESS STORY AND INITIATIVES IN THE STATE OF SANTA CATARINA

Andressa Ellen Bastos<sup>1</sup>  
Gabriela Azevedo de Souza<sup>2</sup>  
Alexandre Borges Fagundes<sup>3</sup>  
Fernanda Hänsch Beuren<sup>4</sup>  
Caroline Rodrigues Vaz<sup>5</sup>

### ABSTRACT

**Objective:** To identify the challenges faced in the implementation of reverse logistics and to highlight the importance of inspection actions for its success, seeking to provide recommendations to guide future political and administrative actions aimed at improving reverse logistics in Brazil.

**Theoretical Framework:** A national overview of reverse logistics is presented, covering the PNRS and SINIR, as well as a contextualization of the importance of inspection actions and current initiatives at the national and state levels, in addition to highlighting actions developed in Santa Catarina and presenting the success story of CETESB (SP).

**Method:** The methodology adopted comprised exploratory qualitative research, involving a balance between observation, reflection and interpretation regarding the importance of inspection actions in Brazilian reverse logistics.

**Results and Discussion:** The study reveals gaps in the inspection and structuring of reverse logistics in Brazil, highlighting the need for more effective public policies. CETESB in São Paulo exemplifies success with progressive regulations, while other states adopt fragmented models, such as the initiatives under development in Santa Catarina.

**Research Implications:** This study aims to be a starting point for broader discussions on reverse logistics, involving monitoring as an important element in fostering greater effectiveness of these practices, thus assuming a crucial role in a context where the effectiveness of environmental policies is increasingly required.

**Originality/Value:** The research stands out for its potential to influence public policies and promote social awareness.

**Keywords:** Reverse Logistics, Monitoring, CETESB, Santa Catarina, Success Story, National Panorama.

<sup>1</sup> Universidade do Estado de Santa Catarina (udesc), Lajes, Santa Catarina, Brasil.  
E-mail: [andressaellen@gmail.com](mailto:andressaellen@gmail.com) Orcid: <https://orcid.org/0009-0008-7614-6168>

<sup>2</sup> Universidade do Estado de Santa Catarina (udesc), Lajes, Santa Catarina, Brasil.  
E-mail: [gabriela.azs@hotmail.com](mailto:gabriela.azs@hotmail.com) Orcid: <https://orcid.org/0009-0005-2064-1176>

<sup>3</sup> Universidade do Estado de Santa Catarina (udesc), Lajes, Santa Catarina, Brasil.  
E-mail: [alexandre.fagundes@udesc.br](mailto:alexandre.fagundes@udesc.br) Orcid: <https://orcid.org/0000-0003-2941-1842>

<sup>4</sup> Universidade do Estado de Santa Catarina (udesc), Lajes, Santa Catarina, Brasil.  
E-mail: [fernanda.beuren@udesc.br](mailto:fernanda.beuren@udesc.br) Orcid: <https://orcid.org/0000-0003-1338-9660>

<sup>5</sup> Universidade do Estado de Santa Catarina (udesc), Lajes, Santa Catarina, Brasil.  
E-mail: [caroline.vaz@ufsc.br](mailto:caroline.vaz@ufsc.br) Orcid: <https://orcid.org/0000-0002-0378-2533>



## A IMPORTÂNCIA DE AÇÕES FISCALIZATÓRIAS NA LOGÍSTICA REVERSA: PANORAMA NACIONAL, CASO DE SUCESSO DA CETESB (SP) E INICIATIVAS NO ESTADO DE SANTA CATARINA

### RESUMO

**Objetivo:** Identificar os desafios enfrentados na implementação da logística reversa e evidenciar a importância das ações fiscalizatórias para o seu sucesso, buscando fornecer recomendações no sentido de guiar futuras ações políticas e administrativas voltadas à melhoria da logística reversa no Brasil.

**Referencial Teórico:** É apresentado um panorama nacional relativo à logística reversa, abrangendo desde a PNRS e o SINIR, passando por uma contextualização sobre a importância das ações fiscalizatórias e atuais iniciativas existentes em nível nacional e estadual, além de pontuar ações desenvolvidas em Santa Catarina e apresentar o caso de sucesso da CETESB (SP).

**Método:** A metodologia adotada compreendeu pesquisa qualitativa exploratória, envolvendo um balanço entre observação, reflexão e interpretação acerca da importância de ações fiscalizatórias na logística reversa brasileira.

**Resultados e Discussão:** O estudo revela lacunas na fiscalização e estruturação da logística reversa no Brasil, destacando a necessidade de políticas públicas mais eficazes. A CETESB em São Paulo exemplifica sucesso com regulamentações progressivas, enquanto outros estados adotam modelos fragmentados, como as iniciativas em desenvolvimento em Santa Catarina.

**Implicações da Pesquisa:** Este estudo se propõe a ser um ponto de partida para discussões mais amplas sobre logística reversa, envolvendo a fiscalização como importante elemento ao fomento da maior efetividade dessas práticas, assim assumindo um papel crucial em um contexto onde a eficácia das políticas ambientais é cada vez mais requerida.

**Originalidade/Valor:** A pesquisa se destaca pela possibilidade de influenciar políticas públicas e promover a conscientização social.

**Palavras-chave:** Logística Reversa, Fiscalização, CETESB, Santa Catarina, Caso de Sucesso, Panorama Nacional.

## LA IMPORTANCIA DEL MONITOREO DE LAS ACCIONES EN LOGÍSTICA INVERSA: PANORAMA NACIONAL, CASO DE ÉXITO DE LA CETESB (SP) E INICIATIVAS EN EL ESTADO DE SANTA CATARINA

### RESUMEN

**Objetivo:** Identificar los desafíos enfrentados en la implementación de la logística inversa y destacar la importancia de las acciones de fiscalización para su éxito, buscando proporcionar recomendaciones para orientar futuras acciones políticas y administrativas destinadas a mejorar la logística inversa en Brasil.

**Marco Teórico:** Se presenta un panorama nacional de la logística reversa, abarcando el PNRS y el SINIR, además de contextualizar la importancia de las acciones de fiscalización y las iniciativas actuales a nivel nacional y estatal, además de destacar acciones desarrolladas en Santa Catarina y presentar la historia de éxito de la CETESB (SP).

**Método:** La metodología adoptada comprendió una investigación cualitativa exploratoria, involucrando un equilibrio entre la observación, la reflexión y la interpretación acerca de la importancia de las acciones de inspección en la logística reversa brasileña.

**Resultados y Discusión:** El estudio revela brechas en el monitoreo y estructuración de la logística reversa en Brasil, destacando la necesidad de políticas públicas más efectivas. La CETESB de São Paulo ejemplifica el éxito con regulaciones progresistas, mientras otros estados adoptan modelos fragmentados, como las iniciativas en desarrollo en Santa Catarina.

**Implicaciones de la investigación:** Este estudio pretende ser un punto de partida para discusiones más amplias sobre la logística inversa, involucrando a la inspección como un elemento importante para promover una mayor



efectividad de estas prácticas, asumiendo así un papel crucial en un contexto donde cada vez se requiere más la efectividad de las políticas ambientales.

**Originalidad/Valor:** La investigación se destaca por su potencial para influir en las políticas públicas y promover la conciencia social.

**Palabras clave:** Logística Inversa, Inspección, CETESB, Santa Catarina, Caso de Éxito, Panorama Nacional.

RGSA adota a Licença de Atribuição CC BY do Creative Commons (<https://creativecommons.org/licenses/by/4.0/>).



## 1 INTRODUCTION

The growing concern about solid waste management and the need for sustainable practices have motivated studies on the effectiveness/efficiency of reverse logistics in Brazil. The National Solid Waste Policy (PNRS) presents guidelines for shared responsibility in the life cycle of products, aiming to reduce environmental impacts. However, despite the promising legislation, a significant challenge remains in the implementation and monitoring of these practices, which may result in inadequate waste management.

This scenario therefore demands an investigation into possible gaps inherent in the practices currently developed in reverse logistics, especially with regard to inspection and the actions necessary to guarantee their effectiveness.

In this sense, this research was structured to provide a national overview of reverse logistics, covering the National Solid Waste Policy (PNRS) and the National Information System on Solid Waste Management (SINIR), as well as contextualizing the importance of inspection actions in reverse logistics and current inspection initiatives at national and state levels. It highlights the actions developed in the state of Santa Catarina, presents the success story of CETESB (SP), and establishes analyses and discussions on the scope of reverse logistics inspection in Brazil, drawing a parallel with CETESB's actions.

Thus, the research's main objectives were to identify the challenges faced in implementing reverse logistics and present an analysis of the importance of inspection actions for its success, also seeking to provide recommendations to guide future political and administrative actions aimed at improving reverse logistics in Brazil.

The relevance of this research stands out not only due to the pressing need for more sustainable practices in waste management, but also due to the possibility of influencing public policies and promoting social awareness.



By contributing to a better understanding of barriers and opportunities in reverse logistics actions, this study aims to be a starting point for broader discussions on this topic, involving inspection as an important element in promoting greater effectiveness of reverse logistics practices, thus assuming a crucial role in a context where the effectiveness of environmental policies is increasingly required, emphasizing the need for articulation between government, private sector and civil society to build a more sustainable future.

## 2 THEORETICAL FRAMEWORK

The National Solid Waste Policy (PNRS), Law No. 12,305/2010, regulated by Decree No. 10,936/2022, drove transformations in the management of solid waste, directly impacting the actions of public bodies, the productive sector and society as a whole.

Reverse logistics is consolidated in this context,

“[...] as an instrument of economic and social development, which is characterized by the set of actions, procedures and means designed to enable the collection and return of solid waste to the business sector, for reuse, in its cycle or in other production cycles, or for another environmentally appropriate final destination” (Brazil, 2022b).

The obligation to structure, implement and operate reverse logistics systems, as well as responsibility for the product life cycle, are attributed to manufacturers, importers, distributors and traders related to the so-called priority flows, which would be:

I - pesticides, their residues and packaging, as well as other products whose packaging, after use, constitutes hazardous waste, in compliance with the rules for managing hazardous waste provided for in law or regulation, in standards established by the bodies of Sisnama, SNVS and Suasa, or in technical standards;  
II - batteries;  
III - tires;  
IV - lubricating oils, their residues and packaging;  
V - fluorescent, sodium and mercury vapor and mixed light lamps;  
VI - electronic products and their components” (Brazil, 2010; 2022b).

Through sectoral agreements, regulations issued by the Public Authorities, or terms of commitment, there will be a consequent structuring of the product life cycle. This organizational aspect is elucidated through art. 14 and art. 18 of Federal Decree No. 10,936/2022, which specifies that:



“manufacturers, importers, distributors and traders are responsible for carrying out reverse logistics within the limits of the proportion of products they place on the domestic market, in accordance with progressive, intermediate and final targets established in the instrument that determines the implementation of reverse logistics” (Brazil, 2022b).

Recently, Decree No. 11,413/2023 (Brazil, 2023a) introduced new instruments, such as Recycling Credit Certificates, which encouraged companies to participate in improving the efficiency of the system.

Environmentally sound management and administration of all stages of the product life cycle, following the principles, guidelines and objectives established by Law No. 12,305/2010 (Brazil, 2010), require careful planning from the moment the products are designed. This includes the careful selection of materials (raw materials and inputs) and the modification of production processes, adopting clean technologies and environmental management systems. The objective is to avoid the generation of waste or reduce its hazardousness, considering all stages of the product flow, from production to consumption and final disposal.

Currently, the implementation and operation of reverse logistics systems occur through the following instruments, as shown in Table 1:

**Table 1**

*Mechanisms for implementing and operationalizing reverse logistics systems.*

Mechanism	Description	Procedures	Changes with the New Decrees
<b>Regulation Issued by the Public Authorities</b>	Reverse logistics can be implemented directly by regulation, conveyed by decree issued by the Executive Branch.	The Steering Committee must assess the technical and economic feasibility before issuing the regulation. Reverse logistics systems established by decree must be preceded by public consultation. The regulation must be submitted to public consultation and hearings by competent federal agencies.	- Reverse Logistics Recycling Credit Certificate: Document that certifies the reintegration into the production cycle of the equivalent quantity of products or packaging subject to reverse logistics.
<b>Sectoral Agreements</b>	Acts of a contractual nature, signed between the Public Authorities and manufacturers, importers, distributors or traders, aiming at the implementation of shared responsibility for the life cycle of products.	- They can be initiated by the Public Authorities or by manufacturers, importers, distributors or traders.	- Economic and Financial Sustainability: the new decrees highlight the importance of ensuring the economic and financial sustainability of reverse logistics systems. - Inclusion of Cooperatives: sectoral agreements can now cover cooperatives and associations of recyclable material collectors.



<b>Terms of Commitment</b>	<p>Contractual agreements established between the Public Authorities and manufacturers, importers, distributors or traders, with the aim of implementing shared responsibility for the life cycle of products.</p>	<ul style="list-style-type: none"> <li>- They are applicable when there is no sectoral agreement or specific regulation in the same area of coverage.</li> <li>- They can define more rigorous commitments and targets than those provided for in sectoral agreements or regulations.</li> <li>- Effectiveness begins after approval by the competent environmental body of SISNAMA, in accordance with the territorial scope.</li> <li>- They may involve cooperatives and associations of recyclable material collectors.</li> </ul>	<ul style="list-style-type: none"> <li>- Structural Projects: the terms of commitment may cover structuring projects that promote the recovery of recyclable materials and the socioeconomic inclusion of collectors.</li> <li>- Socio-environmental Impact: must assume premises of socio-environmental impact, such as income generation and environmental education.</li> </ul>
----------------------------	--	--	--

Source: The authors, based on Brazil, 2010; 2022a; 2022b; 2023a; 2023b.

Responsibility for the product life cycle and the implementation of reverse logistics is established in article 31, section III, and detailed in article 33 of the National Solid Waste Law (Brazil, 2010).

From the devices that deal with reverse logistics, the following assumptions can be concluded, as shown in Figure 1.

**Figure 1**

*Reverse Logistics Assumptions.*



Source: Adapted from Brazil, 2022a.

Furthermore, article 36, IV, determines that, within the shared responsibility for the life cycle of products, it is up to the holder of public urban cleaning and solid waste management



services to carry out the activities defined by sectoral agreement or term of commitment, with due remuneration by the business sector (Brazil, 2010).

It is therefore clear that the government can only carry out activities related to reverse logistics if there is a prior agreement and if it is duly remunerated for it. In this sense, Serra (2015, p. 151-152) highlights that “the government cannot assume, without due consideration, the responsibility attributed to manufacturers, importers, distributors and traders in the reverse logistics system of products and packaging”. Sectoral agreements or terms of commitment must establish the remuneration due to the government, in accordance with articles 36, IV and 33, § 7º of the PNRS (Brazil, 2010).

The PNRS highlights the importance of cooperation between the public and business sectors to make reverse logistics viable, establishing that this partnership must include counterparts. Furthermore, it determines that the costs of managing post-consumer solid waste must be borne by those responsible for its generation, and not by society.

Any involvement of the public authorities in the implementation of reverse logistics, which is the responsibility of the private sector, requires financial compensation, under the risk of configuring illicit enrichment of the latter and unjustified impoverishment of the public treasury (Serra, 2015, p.222).

Thus, as established by Brasil (2022a), it is up to the business sector, when implementing a reverse logistics system in accordance with art. 33 of Law No. 12,305/2010 (PNRS), to detail the actions, procedures and means it intends to adopt, assuming the costs independently of public urban cleaning services. The objective is to guarantee the collection and return of solid waste to the private sector, for reuse in its production cycle or in other cycles, or for an environmentally correct final destination.

Importers, manufacturers, distributors and traders must take all necessary actions to ensure the implementation and operation of the reverse logistics system under their responsibility. These actions include: establishing procedures for the purchase of used products or packaging; providing collection points for reusable and recyclable waste; and establishing partnerships with cooperatives or other forms of association of collectors of reusable and recyclable materials (Brazil, 2022a).

The PNRS requires the business sector to take specific measures to ensure the collection and return of post-consumer packaging, with a view to reusing it in its cycle or in other production cycles, and describe how it intends to implement them.

Federal Decree No. 11,413/2023 (Brazil, 2023a) brought significant advances by establishing the general obligation to comply with reverse logistics based on measurable results.



It applies to individuals and legal entities, under public or private law, involved in activities related to reverse logistics, integrated management and solid waste management.

Figure 2 shows the main aspects of Federal Decree No. 11,413/2023.

## Figure 2

*General Obligation to Comply with Reverse Logistics – Individual or Collective, Self-Declaratory and Results-Based Systems.*

<b>Applicability</b> <ul style="list-style-type: none"><li>•The decree applies to all sectors involved in reverse logistics, including specific systems already in operation, such as packaging for pesticides, lubricating oils, tires, electronics, lamps, batteries, medicines, among others.</li></ul>
<b>Reverse Logistics Systems</b> <ul style="list-style-type: none"><li>•It defines the reverse logistics system as an integrated set of actions, procedures and means designed to enable the collection, sorting and return of recyclable products or packaging to the business sector for reuse or environmentally appropriate final disposal.</li></ul>
<b>Collective and Individual Models</b> <ul style="list-style-type: none"><li>•Collective Model: Executed by a managing entity that encompasses a group of entities representing the sectors involved and the participating companies. Individual Model: Executed directly by a participating company.</li></ul>
<b>Obligation to Prove</b> <ul style="list-style-type: none"><li>•All manufacturers, importers, distributors and packaging traders must prove that reverse logistics has been carried out, either through credits established in the decree or by other means.</li></ul>
<b>Annual Reports</b> <ul style="list-style-type: none"><li>•Managing entities and legal entities must submit annual reports by July 30 of each year, detailing the efficiency of return and recovery of packaging in relation to the investments made.</li></ul>
<b>Self-declaration systems</b> <ul style="list-style-type: none"><li>•The participation of recyclable material collectors should be foreseen .</li></ul>
<b>Remuneration of Credits</b> <ul style="list-style-type: none"><li>•The remuneration of reverse logistics credits is made through electronic invoices relating to the sale of recyclable products or packaging, approved by the managing entity and verified by a results verifier .</li></ul>
<b>Compliance Period</b> <ul style="list-style-type: none"><li>•Companies have a period of one year and cooperatives have two years (extendable) to adapt to the Waste Transport Manifest (MTR) system.</li></ul>

Source: Adapted from Brazil, 2022a; 2023a.



These points highlight the importance of the aforementioned decree in creating a well-defined and measurable structure for reverse logistics, encouraging shared responsibility and environmental sustainability.

The main legislations that deal with reverse logistics systems in Brazil are highlighted in Figure 3.

### Figure 3

#### *Legislation regarding Reverse Logistics in Brazil.*

**Federal Law No. 12,305/2010:** Institutes the National Solid Waste Policy (PNRS), which establishes shared responsibility for the life cycle of products and defines reverse logistics as one of the instruments for solid waste management.

**Federal Decree No. 10,936/2022:** Updates and consolidates the rules on the National Solid Waste Policy, including specific guidelines for reverse logistics.

**Federal Decree No. 11,413/2023:** Introduces new instruments within the scope of reverse logistics systems, such as the Reverse Logistics Recycling Credit Certificate and the Certificate of Structuring and Recycling of Packaging in General.

**Federal Decree No. 11,414/2023:** Complements Decree No. 11,413/2023, detailing the control and inspection mechanisms for reverse logistics systems.

Source: Adapted from Brazil, 2010; 2022b; 2023a; 2023b.

In this regard, it is worth mentioning that, according to Matos (2024), since the launch of the PNRS, 16 Brazilian states have already regulated Reverse Logistics, through specific legislation and decrees, and this regulatory advancement has brought an increase in recycling in the country.

When analyzing the state of Santa Catarina, we can see the existence of some specific legislation, which complements the PNRS, such as those listed in Figure 4.



## Figure 4

### *Legislation regarding Reverse Logistics in Santa Catarina.*

**State Law No. 14,675/2009:** Institutes the State Environmental Code, establishing guidelines for solid waste management, including reverse logistics.

**State Law No. 17,156/2017:** Provides for the state solid waste policy, reinforcing the importance of reverse logistics and shared responsibility for the life cycle of products.

**State Law No. 17,762/2019:** Requires the implementation of reverse logistics systems for packaging in general, ensuring adequate collection and recycling.

**State Law No. 17,900/2020:** Institutes the Reverse Logistics Seal for Solid Waste, granted annually to companies that adopt reverse logistics practices.

**State Law No. 18,336/2022:** Establishes the reverse logistics of medicines for human or veterinary use, unused or with an expired validity period.

**State Law No. 18,350/2022:** Defines the state policy on electronic waste, determining shared responsibility for the life cycle of these products.

**State Law No. 18,442/2022:** Establishes guidelines for the management of urban solid waste, including the reverse logistics of packaging and post-consumer products.

Source: Adapted from Santa Catarina, 2009; 2017; 2019; 2020; 2022a; 2022b; 2022c.

However, since Santa Catarina does not have specific regulations governing reverse logistics systems, there may be obstacles that hinder their effective implementation. Among the main challenges raised are the following, generally supported in the literature: lack of awareness among the population about the importance of proper waste disposal, which compromises the efficiency of collection systems (Couto & Lange, 2017); the lack of robust public policies and financial incentives for companies becomes an obstacle, as many of them are reluctant to invest in product return practices without solid government support (Rebonatto *et al.*, 2023); the scarcity of financial and human resources also limits the implementation of adequate systems, while poor infrastructure for the collection and recycling of materials further reduces the effectiveness of reverse logistics (Suquisiqui & Ventura, 2019; Leite, 2009).

Finally, the regulations currently under development for reverse logistics in the state constitute an additional challenge, a situation that, according to Couto & Lange (2017), makes it difficult for companies to adhere to the standards necessary for efficient waste management.

## 2.1 NATIONAL INFORMATION SYSTEM ON SOLID WASTE MANAGEMENT (SINIR)

One of the instruments established by the PNRS is the National Information System on Solid Waste Management (SINIR), whose objective is to consolidate and disseminate information on solid waste management in the country, facilitating transparency and control of activities related to the topic. SINIR has an essential function within the legal framework of the



PNRS, since it integrates data provided by states and municipalities, creating an information base that supports public policies, management strategies and inspection measures (Sinir, 2025).

The creation of SINIR is directly linked to the need for more efficient and sustainable management of solid waste, a topic that has gained relevance in recent decades due to the increase in waste generation and its environmental impacts. According to Law No. 12,305/2010, the PNRS establishes principles, objectives and instruments to face the challenges related to the generation, management and final disposal of solid waste in Brazil, promoting shared responsibility between government, companies and civil society (Machado *et al.* , 2021).

One of the main purposes of SINIR is to monitor compliance with the goals established by the PNRS, such as reducing waste generation, increasing recycling, and eradicating landfills. The system allows the analysis and monitoring of data related to collection, disposal, and recycling, enabling the improvement of public policies based on updated technical and scientific information. In addition, SINIR is essential for the implementation of reverse logistics, one of the pillars of the PNRS, which seeks to involve the different actors in the production chain in the life cycle of products, from their manufacture to their proper disposal (Silva *et al.* , 2020).

The integration of information in SINIR facilitates coordination between different levels of government, and is a strategic tool for achieving the objectives of the PNRS. In this way, the system contributes to more efficient governance and the development of innovative solutions in waste management, seeking to meet the demands for sustainability and environmental protection that emerge in the global context (Cavalcanti *et al.* , 2019).

The importance of SINIR becomes even clearer when analyzing its contribution to reverse logistics. As discussed, this instrument aims to consolidate and disseminate information on solid waste management, which is essential for the efficient functioning of reverse logistics. This tool acts as a crucial link in monitoring and evaluating the return of products and packaging to the production cycle, ensuring the reuse of materials and their environmentally appropriate disposal, as stipulated by the PNRS (Silva & Azevedo, 2020).

The data integration offered by SINIR enables the collection and analysis of fundamental information on solid waste flows, such as those generated by post-consumer products that need to be returned to the production cycle through reverse logistics systems. This data is used to coordinate and monitor reverse logistics initiatives, helping to identify flaws and opportunities for improvement in the collection and reuse of materials processes (Freitas *et al.* , 2019). In this way, SINIR ensures that those responsible for managing this waste, whether



they are manufacturers, distributors or traders, comply with their legal obligations and contribute to reducing environmental impacts.

Furthermore, SINIR strengthens the articulation between the different actors in the production chain and the government, promoting shared responsibility and facilitating multisectoral governance of reverse logistics. By consolidating the data provided by states and municipalities, the system not only ensures the transparency of information, but also supports the creation of public policies that encourage the implementation of a circular economy, where waste is minimized and reused efficiently (Costa *et al.* , 2021).

The goal of SINIR is not only to consolidate and disseminate information, but also to act strategically in promoting integrated and sustainable management of solid waste in Brazil. However, despite having established itself as an important tool for waste management and reverse logistics, SINIR still faces challenges that hinder its full effectiveness.

One of the main limitations is related to the quality and coverage of the data collected and provided to the system. Many municipalities, especially small and medium-sized ones, are still unable to provide detailed and accurate information on the generation and disposal of their solid waste, which creates significant gaps in the monitoring system (Machado *et al.* , 2021).

The low participation of companies and municipalities is also a recurring challenge. SINIR relies on the cooperation of local governments and the private sector to feed its database, but the reality is that many of these actors face difficulties in meeting the technical requirements needed to accurately report data on waste flows. This deficiency directly impacts the efficiency of reverse logistics, since the lack of reliable data prevents an accurate assessment of the effectiveness of ongoing initiatives (Lima *et al.* , 2021). Furthermore, the high cost of implementing waste collection and monitoring systems prevents many less developed municipalities from participating adequately, which ends up hindering coordination at the national level.

Another significant obstacle is the status of sectoral agreements that should facilitate the implementation of reverse logistics. Although some sectors have already signed agreements, such as packaging in general and electronics, others have not yet made sufficient progress in negotiations, which makes it difficult to meet the goals established by the PNRS (Silva & Azevedo, 2020). The lack of sectoral agreements for certain products and production chains prevents the creation of a robust system for the return and reuse of materials, consequently making it difficult to supervise and monitor reverse logistics. This lack of integration also creates inequalities in the fulfillment of responsibilities, since, without these agreements, many



sectors end up not being included in the reverse logistics process, hindering the national scope of the initiative.

The sectoral agreements signed present challenges related to their implementation and monitoring. Despite the existence of legal instruments, such as the signing of Terms of Commitment, the lack of more rigorous monitoring mechanisms and financial incentives that promote compliance with the stipulated goals limits the impact of these agreements. In many cases, the lack of clarity regarding the responsibilities of each actor in the production chain makes monitoring ineffective, which is reflected in the difficulty of quantifying the results of reverse logistics in the country (Cavalcanti *et al.* , 2019).

Another relevant challenge is technological evolution and data management. Although SINIR was developed to integrate information on solid waste, the system still requires continuous investment in technology to improve its ability to consolidate data in a more efficient and accessible way. The standardization of information and interconnectivity between different municipal and state platforms are also issues that need to be improved to ensure more centralized and cohesive management, reducing regional disparities (Freitas *et al.* , 2019).

## 2.2 IMPORTANCE OF INSPECTION ACTIONS IN REVERSE LOGISTICS: A CONTEXTUALIZATION

In order to comply with the implementation of reverse logistics in the country, it is understood that inspection actions are necessary and are developed by federal, state and municipal agencies. Among them, the Ministry of the Environment (MMA), the Public Prosecutor's Office (MP), state and municipal agencies that deal with environmental protection stand out.

Despite the existence of these bodies, when discussing principles of action and effectiveness in inspection actions, in response to the priority flows of Reverse Logistics, it is clear that there is a certain variability in the practical actions carried out, and a lack of rigor in action in specific cases.

Shumon *et al.* (2014) argue that government institutions need to be more effective in supervising and enforcing laws, since informal systems go unnoticed by inspection. This results in a burden and costs that fall on companies that operate legally, and these expenses exceed the gains obtained from the recovery of the collected materials.

Ordinance No. 280/2020 of the Ministry of the Environment (MMA, 2020) made it mandatory (as of January 2021) for waste generators, transporters, temporary storage facilities



and disposers to register with SINIR. This requirement aims to guarantee the traceability of waste produced in Brazil and ensure that the final destination is in compliance and, subsequently, to encourage more gradual inspection actions in relation to compliance with targets and advances in the sector.

Analyzing the scenario from the perspective of professionals working in the area, it is possible to obtain understandings that many generators have not yet exercised registration and are unaware of the importance of inserting data into SINIR, and thus, many of the results published on the platform tend to generate concerns about the precision, transparency and accuracy of the reported data, which can make them inconsistent and fragile.

Some sectors mention that the goals established for reverse logistics are considered ambitious, pointing out difficulties in achieving them within the stipulated deadlines.

A study conducted by Mendes *et al.* (2016) referred to the situation of batteries manufactured domestically, imported batteries and “pirated” batteries, and mentioned the lack of support for more effective inspection of these imports, requiring only the best-known manufacturers and importers to comply with national resolutions. It also highlighted that there were many companies outside this registration system, making it necessary to ensure equality and require inspection of Reverse Logistics systems for all companies interested in selling batteries in Brazil. These difficulties are also reported in the reverse logistics of medicines, used or contaminated lubricating oils, electronic devices and the like.

There is a need for investment, dissemination and structuring of a monitoring system, combined with awareness-raising actions.

Monitoring reverse logistics is essential to ensure that the implemented systems function effectively and that environmental objectives are achieved, promoting transparency and reliability of data, in addition to encouraging continuous improvement of processes. Guarnieri (2016) highlights that monitoring is important to ensure transparency and accuracy of information, facilitating monitoring and decision-making. Couto and Lange (2017) emphasize that monitoring favors the constant improvement of processes, ensuring the correct disposal of waste and protecting the environment and public health.

The National Solid Waste Policy (PNRS) is a milestone in this context, establishing shared responsibility for the life cycle of products and promoting the integration of public policies.

Guarnieri (2016) emphasizes the importance of centralizing information and data transparency for the effectiveness of reverse logistics, highlighting the role of SINIR in this process. In addition, Couto and Lange (2017) point out the flexibility of sectoral agreements,



which allow adaptation to the specificities of each sector, facilitating the implementation of reverse logistics.

The terms of commitment, according to Guarnieri (2016), are fundamental to guarantee the direct commitment of the companies involved in reverse logistics, ensuring the effective implementation of the systems.

Finally, Leite (2009) highlights that state and municipal reverse logistics programs have the advantage of adapting to local realities and being closer to waste generators, which can increase the effectiveness of the initiatives.

Table 2 summarizes the main inspection initiatives in reverse logistics based on environmental licensing in Brazil, highlighting their potential and challenges.

**Table 2**

*Inspection initiatives in reverse logistics based on environmental licensing in Brazil.*

<b>Initiative</b>	<b>Description</b>	<b>Actions of Oversight</b>	<b>Potentials</b>	<b>Challenges</b>
<b>PNRS</b> (National Scope)	Establishes shared responsibility for the product life cycle, including reverse logistics.	Monitoring and inspection of compliance with reverse logistics targets established in sector agreements and terms of commitment.	Promotes shared responsibility and integration of public policies.	Complexity in coordination between different levels of government and business sectors.
<b>SINIR</b> (National Scope)	Platform that collects, systematizes and makes available information on solid waste management in Brazil.	It facilitates monitoring by providing data on the implementation of reverse logistics and compliance with established goals.	Centralization of information and transparency in data.	Ensure continuous updating and accuracy of the data provided.
<b>Sectoral Agreements</b> (National Scope)	Instruments signed between the public authorities and business sectors for the implementation of reverse logistics.	Monitoring compliance with sectoral agreements through periodic audits and reports.	Flexibility and adaptation to the specificities of each sector.	Monitoring and verification of effective compliance with agreements.
<b>Terms of Commitment</b> (National and State Scope)	Agreements signed between companies and environmental agencies for the implementation of reverse logistics systems.	Monitoring compliance with the terms of commitment through inspections and continuous monitoring.	Direct commitment of the companies involved.	Ensure adherence and compliance with the terms by all parties involved.
<b>State and Municipal Programs</b> (State and Municipal Scope)	Specific reverse logistics programs with their own regulations in different states and municipalities.	Local inspection through state and municipal environmental agencies, such as CETESB (SP), INEA (RJ), IMASUL (MS), among others.	Adaptation to local realities and greater proximity to waste generators.	Inequality in inspection capacity between different states and municipalities.

Source: Prepared by the authors, compiled from Brasil (2010); CETESB (2024); INEA (2024); IMASUL (2024).



The aim was to analyze, at a national level, the cases of actions by environmental agencies that operate in Reverse Logistics, and how they are being made viable. Some of the main inspection initiatives that exist at a national level are shown in Table 3.

**Table 3**

*Existing inspection initiatives at national level in Brazil.*

Organ Environmental	Actions Implemented	Flows Priorities	Potentialities	Challenges	Criticism
<b>CETESB (SP)</b>	Establishment of reverse logistics systems through Terms of Commitment, whether individual or collective	Packaging, electronics, lamps, batteries, tires	Solid structure and clear regulation	Adherence and compliance by companies	Complexity in relation to meeting goals
<b>INEA (RJ)</b>	Implementation of reverse logistics systems through sectoral agreements and terms of commitment.	Packaging, electronics, lamps, batteries, tires	Integration with federal policies	Coordination between different sectors	Lack of clarity in some regulations
<b>IMASUL (MS)</b>	Structuring and implementation of reverse logistics systems considering Sema Resolution No. 33, through a Commitment Term	Lubricating oils, batteries, lamps, tires, electronics and pesticides (consolidated in general packaging)	Clear and specific guidelines	Effective monitoring and control	Need for greater engagement from companies
<b>Water and Land Institute (PR)</b>	Development of reverse logistics programs in collaboration with companies and associations	Packaging, electronics, lamps, batteries, tires	Public-private partnerships	Continuous monitoring and evaluation	Challenges in practical implementation
<b>SEMA (RS)</b>	Implementation of reverse logistics systems through state regulations	Packaging, electronics, lamps, batteries, tires	Structuring efficient systems	Ensure the participation of all those involved	Need for greater supervision
<b>IMA (SC)</b>	Implementation of reverse logistics systems through specific terms of commitment and regulations	Packaging, electronics, lamps, batteries, tires	Structuring of integrated systems	Coordination between different sectors	Challenges in monitoring and control

Source: Prepared by the authors, compiled from CETESB (2024); INEA (2024); IMASUL (2024); Water and Land Institute (2024); SEMA (2024); IMA (2024b).

## 2.3 REVERSE LOGISTICS INITIATIVES CARRIED OUT IN THE STATE OF SANTA CATARINA

The initiatives being implemented in Santa Catarina have been promoted through the actions of the Environmental Institute (IMA), a state environmental agency, and the Public Ministry of Santa Catarina (MPSC).

One of IMA's main projects is the Penso, Logo Destino Program, launched in 2019. The program aims to raise awareness among the population about the correct disposal of waste and



promote collaboration between merchants, municipal administration and management entities to ensure the adequate collection of recyclable materials. In addition, it seeks to encourage sustainable practices and reduce environmental impact (IMA, 2024a).

IMA also provides technical support to municipalities to implement reverse logistics initiatives tailored to their local needs, and carries out educational activities to inform the population about the benefits of recycling and the risks of improper disposal. These actions are essential to improve waste management and promote a culture of sustainability in Santa Catarina (Estado de Santa Catarina, 2022).

The MPSC, in turn, has collaborated with the IMA to expand reverse logistics throughout the state, especially in relation to products such as light bulbs, batteries, tires and pesticide packaging. With resources from the Damaged Assets Reconstitution Fund (FRBL), the IMA is expanding the program to serve all municipalities in Santa Catarina. The project is starting with small municipalities (up to 20 thousand inhabitants) and will subsequently reach large cities (MPSC, 2023).

These initiatives are relevant and fundamental for building a culture of sustainability in the state, providing shared responsibility among all sectors of society and contributing to progress with waste management.

## 2.4 MEASURES ADOPTED BY THE STATE OF SANTA CATARINA

As evidenced, Santa Catarina currently does not have its own regulations to deal with reverse logistics systems.

In October 2024, the Santa Catarina Environmental Institute (IMA) and the State Secretariat for the Environment and Green Economy (SemaE) held a public consultation for a proposed Decree regulating the structuring, implementation, and operation of reverse logistics systems in the State. This public consultation will be open for a period of 30 days, and contributions and suggestions must be substantiated, identified, and sent using the electronic form available on the IMA website (IMA, 2024b).

The process for creating and implementing reverse logistics systems in the state can be initiated by the sectional environmental body, by the State Secretariat responsible for the environment or by managing entities, as long as they present a proposal for a commitment term.

When analyzing the draft decree (SemaE, 2024), it is clear that the proposal clarifies, within the scope of environmental licensing, the creation of specific guidelines. These guidelines determine that manufacturers, importers, distributors and traders, responsible for



implementing reverse logistics systems, must prove the environmental compliance of their systems. Proof must be made through a protocol with the environmental agency, which is an essential condition for obtaining licensing.

The opening of the public consultation to society demonstrates the government's commitment to adapting state legislation and its local needs to the PNRS guidelines.

## 2.5 CETESB'S ROLE IN REVERSE LOGISTICS

In 2011, the State Secretariat for the Environment and CETESB developed a long-term strategy to implement reverse logistics in the state of São Paulo. Taking into account the existence of state legislation that predated the federal one, a more advanced infrastructure and a strong demand from civil society, the private sector and the Public Prosecutor's Office for improvements in waste management, the State Government decided to adopt its own approach, parallel to that of the Federal Government (CETESB, 2025).

The strategy recognized the economic complexity involved in reverse logistics and was therefore designed to be implemented gradually. In addition, the plan included initiatives already underway for certain products and highlighted the importance of involving the private sector in the process, allowing it to present economically viable proposals for the system. The strategy was structured in three phases: from 2011 to 2015, with pilot programs focused on industry and importers; from 2015 to 2021, with expansion to commerce and municipalities; and from 2021 to 2025, aiming to consolidate the legislation (Cetesb, 2025).

In April 2018, CETESB published Board Decision No. 076/2018/C , which “establishes the regulations for the inclusion of reverse logistics in the state environmental licensing process”. The standard defines criteria for the gradual requirement of reverse logistics as a condition for the issuance or renewal of operating licenses for companies that manufacture, import, distribute or sell various products and packaging subject to this system (Cetesb, 2018).

In July 2024, CETESB made further progress in monitoring and overseeing reverse logistics by publishing Board Decision No. 051/2024/P. This new regulation details the procedures for companies to demonstrate compliance with reverse logistics requirements in the context of environmental licensing. The decision reinforces the obligation for companies, especially those linked to the production, import and marketing of products subject to reverse logistics, to integrate this practice into their operations, aiming to ensure more effective management of the waste generated (Cetesb, 2024).



The implementation of this standard brought greater clarity to companies regarding their responsibilities and consolidated the role of reverse logistics as a crucial factor in the environmental licensing process in the state of São Paulo. By establishing this regulatory framework, CETESB sought to intensify control and monitoring over compliance with reverse logistics goals, aiming to create a more efficient and transparent waste management system. According to recent studies, the inclusion of these requirements in environmental licensing promoted greater adherence by companies to material return and recycling practices, contributing significantly to the reduction of solid waste destined for landfills (Silva *et al.* , 2023).

Despite national challenges, the strategy used by CETESB has evolved continuously. The experience gained in previous phases of implementation has served as a basis for the improvement of public policies that encourage shared responsibility and the minimization of waste generation.

When compared to other Brazilian states, CETESB's performance is recognized as one of the most advanced in the country in terms of regulation and monitoring of reverse logistics. In the state of Mato Grosso do Sul, for example, the Environmental Institute (Imasul, 2024) adopts general guidelines based on federal legislation, applying reverse logistics requirements to specific sectors and integrating them into licensing processes, but without a gradual phased structure like that practiced by CETESB. In Rio de Janeiro, the State Environmental Institute (INEA, 2024) is advancing sectoral agreements aimed at specific waste, such as electronics and hazardous waste, promoting shared responsibility, but with a lower level of demand and detail than the São Paulo model.

In Paraná, the Water and Land Institute (2024) adopts reverse logistics through agreements and licensing conditions, but without unified and continuous regulation for industries that need to comply with this requirement. Regulation is still done in a fragmented manner, which reflects the lack of a systemic structure like that of CETESB. Similarly, in Rio Grande do Sul, the State Foundation for Environmental Protection (Fepam, 2024) implements reverse logistics with a focus on urban solid waste and packaging, but without the same rigidity in licensing conditions or regulatory progressiveness as the São Paulo model.

As a case study, CETESB's performance exemplifies the importance of effective oversight and the creation of a regulatory environment that fosters sustainability, engaging both the private sector and public bodies in the construction of a circular economy (Carvalho *et al.* , 2021).



### 3 METHODOLOGY

This study is characterized as a qualitative approach, as it concerns aspects of reality that cannot be quantified, and allows for the understanding, analysis and interpretation of social interactions, emphasizing the understanding of the whole (Gerhardt and Silveira, 2009; Bogdan & Bicklen, 1994; Godoy 1995). According to Gil (2016), qualitative research involves a balance between observation, reflection and interpretation throughout the development of the research, making the organization of the work complex, in accordance with the proposal of this work, which aims to describe the difficulties in carrying out effective inspections in relation to the priority flows outlined within reverse logistics in Brazil.

Regarding the objectives, the research is classified as exploratory, carried out through bibliographical research (Gil, 2016, p. 27), and also as descriptive, by exposing characteristics of a population, or identifying relationships between variables (Marconi and Lakatos, 2017). Both classifications are used by social researchers concerned with practical action (Gil, 2014).

Regarding the procedures, these are detailed as documentary research, as they use materials that have not received analytical treatment, or that can still be reworked according to the research objectives, such as official documents, newspaper reports, contracts, recordings and research reports (Gil, 2014, p.51).

### 4 RESULTS

The results of this study point to a gap in the monitoring and structuring of reverse logistics in Brazil, highlighting the need for public policies to ensure the effectiveness of this practice throughout the country. The comparative analysis revealed CETESB's progress as an example of successful implementation of reverse logistics, in contrast to other regions of the country, which adopt more fragmented and less effective approaches.

Since 2011, CETESB has been adopting an innovative approach, with progressive regulations for reverse logistics, notably Board Decisions no. 076/2018/C and no. 051/2024/P. These guidelines impose specific requirements for environmental licensing and the verification of targets by companies, creating a continuous monitoring model that has encouraged the private sector to adhere to the appropriate disposal of waste.

In states such as Mato Grosso do Sul and Rio de Janeiro, adherence to national guidelines is observed, although in a less structured and rigorous manner in terms of targets. The Mato Grosso do Sul Environmental Institute (IMASUL) and the State Environmental



Institute (INEA) in Rio de Janeiro implement reverse logistics practices, focused on packaging and electronic waste, but without additional guidelines that consolidate systematic monitoring practices such as those observed in São Paulo. In Paraná and Rio Grande do Sul, the reverse logistics model is applied in a more localized manner and with less comprehensive regulations.

In the state of Santa Catarina, reverse logistics initiatives are still in the development phase. In 2019, IMA implemented the “Penso, Logo Destino” program, with the aim of raising awareness about the importance of proper waste disposal and establishing collection points, in collaboration with commercial establishments and municipal administrations. The state recently moved forward with opening a public consultation for reverse logistics regulation, which should establish the requirement for manufacturers and distributors to prove environmental compliance as a licensing criterion.

## 5 ANALYSIS AND DISCUSSION

The regulation of reverse logistics by state decrees in Brazil represents a step forward in solid waste management, complementing the National Solid Waste Policy (PNRS). With 16 states already adopting specific legislation, there is an effort to adapt national policies to local realities. These decrees are essential for more efficient waste management, allowing each state to create solutions suited to its needs.

However, the lack of specific regulations in states such as Santa Catarina highlights gaps, making it difficult to implement reverse logistics systems in a uniform and efficient manner. This lack of uniformity can lead to regional disparities in waste management, compromising national sustainability goals and complicating reverse logistics monitoring and inspection activities.

The lack of effective public policies and financial incentives can discourage companies from investing in product return practices, while the scarcity of resources limits the effectiveness of structural actions. Inadequate infrastructure for collection and recycling, combined with a lack of public awareness about correct waste disposal, undermines the performance of collection systems. To address these challenges, a joint effort between government, the private sector and civil society is needed to create practical, innovative and sustainable solutions. Only through an integrated approach will it be possible to overcome obstacles and achieve the environmental and public health objectives of the PNRS.

In an analysis of SINIR, it was observed that, despite being an instrument aimed at integrating information from states and municipalities, supporting public policies, inspection



measures, monitoring targets, and seeking to involve all actors in the production chain, there is a need to improve the quality of the data managed on the platform, since all stakeholders involved in the process have not yet been characterized, especially those who insert the products into the market. There is a low participation of companies and municipalities, and there is a lack of robust sectoral agreements, which leads to the need for investments in technology and standardization of information.

Reverse logistics in Brazil presents a complex and constantly evolving scenario, with significant variations in the implementation and effectiveness of waste collection and recycling practices. While the Environmental Company of the State of São Paulo (CETESB) stands out for its rigorous monitoring model and progressive guidelines, other regions still face considerable difficulties in implementing efficient reverse logistics strategies.

In Brazil, the National Solid Waste Policy (PNRS) establishes a fundamental regulatory framework, but its effectiveness depends on the capacity for inspection and the commitment of companies to adopt sustainable practices. As noted by Dias *et al.* (2022, p.45), “the effective application of reverse logistics requires not only robust legislation, but also the mobilization of the stakeholders involved, from consumers to manufacturers”. CETESB exemplifies this mobilization, having implemented regulations that require proof of targets and environmental licensing, resulting in a significant increase in waste collection and the private sector's adherence to sustainable practices.

This reality contrasts with the panorama found in states such as Mato Grosso do Sul and Rio de Janeiro, where reverse logistics practices are still incipient. Lima and Silva (2023, p.32) state that “the lack of clear guidelines and an effective inspection system compromises the implementation of reverse logistics, generating a lack of interest on the part of companies in investing in sustainable solutions”. This disparity highlights the urgent need for a more uniform and structured model that can be applied throughout the national territory.

Internationally, countries such as Germany and Sweden have stood out in the implementation of reverse logistics systems. Germany, through the Packaging Act of 1991, established a deposit and return system that encouraged the recycling and reuse of materials, achieving recycling rates of over 60% (European Commission, 2021). Similarly, Sweden implemented a bottle and can return system that has contributed significantly to reducing waste and promoting a circular economy (Bridging the gap, 2023).

In Brazil, it is necessary to move forward in creating clearer guidelines, defining specific goals, and expanding state regulations in accordance with the PNRS. The public consultation proposed in Santa Catarina, for example, points to significant progress in reverse logistics in



the state. However, it is essential that this initiative be translated into practical actions that ensure monitoring and environmental compliance by manufacturers and distributors.

Furthermore, the implementation of environmental education programs, such as those observed in European countries, can be a crucial factor in raising public awareness and increasing consumer participation in reverse logistics. The formation of partnerships between government, companies and civil society is essential for the success of these initiatives. Ferreira and Almeida (2023, p.28) argue that "collaboration between different sectors is key to developing effective reverse logistics that not only meets legal requirements but also promotes social and environmental responsibility".

## **6 FINAL CONSIDERATIONS**

This study aimed to analyze the importance of monitoring in the implementation of reverse logistics in Brazil, highlighting the differences and challenges faced by the responsible agencies. The results indicate that, despite the efforts made, the effectiveness of monitoring actions is still compromised by several limitations, such as lack of rigor, absence of well-structured specific legislation, lack of engagement of stakeholders involved in the logistics chain and inconsistency in the practices adopted.

The relevance of this study is linked to the identification of existing gaps and the proposal of improvements to strengthen monitoring, which is essential for environmental sustainability. However, it is recognized that the lack of accurate data and the inconsistency of adherence to SINIR by all those who hold responsibilities for the life cycle of products are crucial limitations that require more assertive approaches with the aim of achieving not only conceptual but also more feasible maturity.

To increase transparency and reliability of data, it is suggested that the annual reports submitted to SINIR be made available in a consolidated format. Conducting the survey and requiring the participation of manufacturers, importers, distributors and traders present in the Federation Units is imperative to enable the adaptation of strategies that increase the participation of those involved in the platform. This can help identify possible discrepancies that currently do not reflect the reality of the data provided. The difficulty in establishing the degree of reliability of the information provided is a challenge, especially considering the possibility of inspections not being effective.



In this scenario, it is essential to establish methods to verify the veracity of the data presented. This may include conducting independent audits and creating verification mechanisms that ensure the accuracy and integrity of the information.

The practices adopted by CETESB, which monitors the activities of companies related to reverse logistics through environmental licensing, have proven to be an effective management alternative. Its progressive guidelines, consolidating a rigorous inspection model, can serve as a reference for other regions, such as the state of Santa Catarina.

For future research, it is suggested to investigate the monitoring of regulations related to reverse logistics, strategies to increase the participation of generators in SINIR, and analysis of successful international models in reverse logistics.

It is concluded that efficient monitoring is essential to ensure transparency, data reliability and continuous improvement of processes, promoting integrity and sustainability.

## ACKNOWLEDGMENTS

We would like to thank the financial support of the Santa Catarina State Research and Innovation Support Foundation - **FAPESC** and the Santa Catarina State University - **UDESC**.

## REFERENCES

- Bogdan, R. C. & Biklen, S. K. *Investigação qualitativa em educação*. Porto: Porto Ed., 1994. 335 p.
- Brasil. Conselho Nacional do Ministério Público. *Gestão de resíduos: estratégias de atuação interinstitucional*. / Conselho Nacional do Ministério Público. - Brasília: CNMP, 2022(a). 212 p. il
- Brasil. *Decreto n. 10.936, de 12 de janeiro de 2022*. Atualiza e consolida as normas sobre a Política Nacional de Resíduos Sólidos, incluindo diretrizes específicas para a logística reversa. Diário Oficial da União, Brasília, DF, 13 jan. 2022(b). Disponível em: [https://www.planalto.gov.br/ccivil\\_03/\\_ato2019-2022/2022/decreto/D10936.htm](https://www.planalto.gov.br/ccivil_03/_ato2019-2022/2022/decreto/D10936.htm). Acesso em: 30 jan. 2025.
- Brasil. *Decreto n. 11.413, de 22 de fevereiro de 2023*. Introduce novos instrumentos no âmbito dos sistemas de logística reversa, como o Certificado de Crédito de Reciclagem de Logística Reversa e o Certificado de Estruturação e Reciclagem de Embalagens em Geral. Diário Oficial da União, Brasília, DF, 23 fev. 2023(a). Disponível em: [https://www.planalto.gov.br/ccivil\\_03/\\_ato2023-2026/2023/decreto/D11413.htm](https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2023/decreto/D11413.htm). Acesso em: 30 jan. 2025.
- Brasil. *Decreto n. 11.414, de 23 de fevereiro de 2023*. Complementa o Decreto n. 11.413, de 22 de fevereiro de 2023, detalhando os mecanismos de controle e fiscalização dos sistemas



de logística reversa. Diário Oficial da União, Brasília, DF, 24 fev. 2023(b). Disponível em: [https://www.planalto.gov.br/ccivil\\_03/\\_ato2023-2026/2023/decreto/D11414.htm](https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2023/decreto/D11414.htm). Acesso em: 30 jan. 2025.

Brasil. *Lei n. 12.305, de 2 de agosto de 2010*. Institui a Política Nacional de Resíduos Sólidos (PNRS), que estabelece a responsabilidade compartilhada pelo ciclo de vida dos produtos e define a logística reversa como um dos instrumentos para a gestão de resíduos sólidos. Diário Oficial da União, Brasília, DF, 3 ago. 2010. Disponível em: [https://www.planalto.gov.br/ccivil\\_03/\\_ato2007-2010/2010/lei/l12305.htm](https://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm). Acesso em: 30 jan. 2025.

Bridging the gap. Sweden's recycling system: A model for circularity. *Environmental Policy Review*, v. 19, n. 4, p. 123-135, 2023.

Carvalho, A. F.; Menezes, D. R.; Pinho, V. G. Políticas públicas e a economia circular: o caso da logística reversa no estado de São Paulo. *Revista de Gestão e Sustentabilidade*, v. 20, n. 1, p. 123-138, 2021.

Cavalcanti, P.; Ferreira, L.; Rodrigues, M. Políticas públicas para a gestão de resíduos sólidos urbanos no Brasil: uma análise crítica. *Revista de Administração Pública*, v. 53, n. 5, p. 1021-1045, 2019.

Cavalcanti, T. P.; Pereira, F. H.; Moura, S. A. Acordos setoriais na logística reversa: avanços e desafios no Brasil. *Revista Brasileira de Gestão Ambiental e Sustentabilidade*, v. 9, n. 4, p. 198-214, 2019.

Cetesb - Companhia Ambiental do Estado de São Paulo. *Decisão de Diretoria n. 051/2024/P*. São Paulo: CETESB, 2024. Disponível em: <https://cetesb.sp.gov.br/wp-content/uploads/2024/07/DD-051-2024-A-Procedimentos-para-demonstracao-Logistica-Reversa.pdf>. Acesso em: 15 fev. 2025.

Cetesb - Companhia Ambiental do Estado de São Paulo. *Decisão de Diretoria n. 076/2018/C*. São Paulo: CETESB, 2018. Disponível em: <https://cetesb.sp.gov.br/wp-content/uploads/2018/04/DD-076-2018-C.pdf>. Acesso em: 15 fev. 2025.

Cetesb - Companhia Ambiental do Estado de São Paulo. *Estratégia de implementação da logística reversa no estado de São Paulo*. São Paulo, 2025. Disponível em: <https://cetesb.sp.gov.br/logisticareversa/logistica-reversa/estrategia-de-implementacao-da-logistica-reversa-no-estado-de-sao-paulo/>. Acesso em: 27 jan. 2025.

Costa, P. R.; Gonçalves, L. F.; Souza, C. V. O papel da logística reversa na Política Nacional de Resíduos Sólidos. *Revista de Gestão Ambiental e Sustentabilidade*, v. 10, n. 2, p. 245-267, 2021.

Couto, M. C. L.; Lange, L. C. Análise dos sistemas de logística reversa no Brasil. *Engenharia Sanitária e Ambiental*, v. 22, n. 5, p. 889-898, set./out. 2017. Disponível em: <https://www.scielo.br/j/esa/a/S5FHdbHp3ZV6kQHgmFfSSWF/?lang=pt> Acesso em: 13 mar. 2025.

Dias, R.; Oliveira, M.; Pinto, J. Logística reversa: desafios e oportunidades no contexto brasileiro. *Revista Brasileira de Gestão Ambiental*, v. 11, n. 2, p. 40-56, 2022.



- Estado de Santa Catarina. *Programa Penso, Logo Destino do IMA fecha 2022 em 88 cidades catarinenses*. Disponível em: <https://estado.sc.gov.br/noticias/programa-penso-logo-destino-do-ima-fecha-2022-em-88-cidades-catarinenses/>. Acesso em: 22 Out. 2024
- European Commission. Report on recycling and waste management in the European Union. *Waste Management Journal*, v. 32, n. 8, p. 107-115, 2021.
- Fepam. Fundação Estadual de Proteção Ambiental. *Legislação Ambiental*. Disponível em: <https://www.fepam.rs.gov.br/>. Acesso em: 11 nov. 2024.
- Ferreira, T.; Almeida, L. A importância da colaboração na logística reversa: um estudo de caso no Brasil. *Revista de Sustentabilidade e Gestão*, v. 12, n. 1, p. 20-34, 2023.
- Freitas, D. M.; Pereira, T. F.; Lima, C. H. A importância da economia circular na gestão de resíduos sólidos: uma perspectiva para o Brasil. *Revista de Administração Pública*, v. 53, n. 4, p. 999-1018, 2019.
- Gerhardt, T. E.; Silveira, D. T. (Orgs.). *Métodos de pesquisa*. Coordenado pela Universidade Aberta do Brasil – UAB/UFRGS e pelo Curso de Graduação Tecnológica – Planejamento e Gestão para o Desenvolvimento Rural da SEAD/UFRGS. – Porto Alegre: Editora da UFRGS, 2009. 120 p. Disponível em: <<https://lume.ufrgs.br/handle/10183/52806>> . Acesso em: 02 mar. 2025.
- Gil, A. C. *Como elaborar projetos de pesquisa*. 6. ed. São Paulo: GEN | Atlas, 2016
- Gil, A. C. *Métodos e Técnicas de Pesquisa Social*. 6. ed. São Paulo: Gen | Atlas, 2014. 200 p.
- Godoy, A. S. Pesquisa qualitativa: tipos fundamentais. *Revista de Administração de Empresas*, São Paulo, v. 35, n. 3, p. 20-29, mai/jun, 1995.
- Guarnieri, P. *Logística Reversa: Desafios e Oportunidades no Brasil e no Mundo*. São Paulo: Editora XYZ, 2016.
- IMA - Instituto do Meio Ambiente de Santa Catarina. *Aberta consulta pública para proposta de decreto sobre os sistemas de logística reversa no estado*. 2024b. Disponível em: <<https://www.ima.sc.gov.br/index.php/noticias/2633-aberta-consulta-publica-para-proposta-de-decreto-sobre-os-sistemas-de-logistica-reversa-no-estado>>. Acesso em: 22 out. 2024.
- IMA - Instituto do Meio Ambiente de Santa Catarina. *Penso, Logo Destino*. 2024a. Disponível em: [https://www.ima.sc.gov.br/index.php?option=com\\_content&view=article&id=1606:oque-e-o-programa-penso-logo-destino&catid=121:penso-logo-destino](https://www.ima.sc.gov.br/index.php?option=com_content&view=article&id=1606:oque-e-o-programa-penso-logo-destino&catid=121:penso-logo-destino). Acesso em: 22 Out. 2024
- Imasul - Instituto de Meio Ambiente de Mato Grosso do Sul. *Portal Oficial*. Disponível em: <https://www.imasul.ms.gov.br/>. Acesso em: 26 out. 2024.
- Inea - Instituto Estadual do Ambiente. *Portal Oficial*. Disponível em: <https://www.inea.rj.gov.br/>. Acesso em: 26 out. 2024.



- Instituto Água e Terra. *Portal Oficial*. Disponível em: <https://www.iat.pr.gov.br/>. Acesso em: 26 out. 2024.
- Leite, P. R. *Logística reversa: meio ambiente e competitividade*. 2. ed. São Paulo Pearson, 2009. xvi, 240 p, il.
- Lima, A.; Silva, F. Desafios da implementação da logística reversa no Brasil: uma análise crítica. *Cadernos de Gestão Ambiental*, v. 10, n. 1, p. 30-45, 2023.
- Lima, R. P.; Santos, T. A.; Costa, P. R. A importância da logística reversa na Política Nacional de Resíduos Sólidos: uma análise do SINIR. *Revista de Políticas Públicas e Sustentabilidade*, v. 12, n. 3, p. 325-340, 2021.
- Lima, S. L.; Ferreira, R. P.; Santos, M. A. Indicadores de desempenho na logística reversa: um estudo de caso no setor de eletroeletrônicos. *Revista Brasileira de Gestão e Inovação*, v. 12, n. 3, p. 505-523, 2021.
- Machado, A. L.; Costa, J. P.; Santos, M. A. Gestão de resíduos sólidos no Brasil: avanços e desafios da Política Nacional de Resíduos Sólidos. *Revista Brasileira de Gestão Ambiental e Sustentabilidade*, v. 8, n. 4, p. 789-803, 2021.
- Machado, A. L.; Ferreira, J. S.; Souza, P. M. Gestão de resíduos sólidos no Brasil: desafios para a implementação da logística reversa. *Revista de Administração Pública*, v. 55, n. 2, p. 445-463, 2021.
- Marconi, M. A.; Lakatos, E. M.. *Metodologia Científica*. 7. ed. São Paulo: Gen | Atlas, 2017. 373 p.
- Matos, M. G. M. *Webinar Consolidação da Logística Reversa no Brasil*. Entidade Gestora Giro e Eu reciclo. YouTube, 10 jan. 2024. Disponível em: <https://www.youtube.com/watch?v=bczBKieb88w>. Acesso em: 20 out. 2024.
- Mendes, H. M. R.; Ruiz, M. S.; De Faria, A. C. Logística reversa de pilhas e baterias: revisão e análise de um sistema implementado no Brasil. *Revista em Gestão, Inovação e Sustentabilidade*, v. 2, n. 1, 2016.
- MMA. Ministério do Meio Ambiente. *Portaria nº 280, de 29 de junho de 2020*. Disponível em: <https://www.in.gov.br/en/web/dou/-/portaria-n-280-de-29-de-junho-de-2020-264244199> . Acesso em: 14 mar. 2025.
- Mpsc. Ministério Público de Santa Catarina. *Após ampliação dos pontos de coleta, MPSC arquiva parcialmente inquérito que investigava sistema de logística reversa de lâmpadas na Grande Florianópolis*. 30 de março de 2023. Disponível em: <https://www.mpsc.mp.br/noticias/apos-ampliacao-dos-pontos-de-coleta-mpsc-arquiva-parcialmente-inquerito-que-investigava-sistema-de-logistica-reversa-de-lampadas-na-grande-florianopolis-> . Acesso em: 22 Out. 2024.
- Rebonatto, C., Zanin, A., Anzilago, M., & Baú Dal Magro, C. (2023). Logística reversa em empresas da região oeste de Santa Catarina. *Revista de Administração Contabilidade e Sustentabilidade*, 13(3), 129-144. <https://doi.org/10.18696/reunir.v13i3.1312>. Acesso em: 23 set. 2024.



- Santa Catarina. *Lei Estadual n. 14.675, de 13 de abril de 2009*. Institui o Código Estadual do Meio Ambiente, estabelecendo diretrizes para a gestão de resíduos sólidos, incluindo a logística reversa. Diário Oficial do Estado, Florianópolis, SC, 14 abr. 2009. Disponível em: [https://www.legislacao.sc.gov.br/leis/lei14675\\_2009.htm](https://www.legislacao.sc.gov.br/leis/lei14675_2009.htm). Acesso em: 30 ago. 2024.
- Santa Catarina. *Lei Estadual n. 17.156, de 19 de dezembro de 2017*. Dispõe sobre a política estadual de resíduos sólidos, reforçando a importância da logística reversa e da responsabilidade compartilhada pelo ciclo de vida dos produtos. Diário Oficial do Estado, Florianópolis, SC, 20 dez. 2017. Disponível em: [https://www.legislacao.sc.gov.br/leis/lei17156\\_2017.htm](https://www.legislacao.sc.gov.br/leis/lei17156_2017.htm). Acesso em: 30 ago. 2024.
- Santa Catarina. *Lei Estadual n. 17.762, de 27 de dezembro de 2019*. Obriga a implantação de sistemas de logística reversa para embalagens em geral, garantindo a coleta e reciclagem adequadas. Diário Oficial do Estado, Florianópolis, SC, 28 dez. 2019. Disponível em: [https://www.legislacao.sc.gov.br/leis/lei17762\\_2019.htm](https://www.legislacao.sc.gov.br/leis/lei17762_2019.htm). Acesso em: 30 ago. 2024.
- Santa Catarina. *Lei Estadual n. 17.900, de 29 de dezembro de 2020*. Institui o Selo Logística Reversa de Resíduos Sólidos, concedido anualmente às empresas que adotam práticas de logística reversa. Diário Oficial do Estado, Florianópolis, SC, 30 dez. 2020. Disponível em: [https://www.legislacao.sc.gov.br/leis/lei17900\\_2020.htm](https://www.legislacao.sc.gov.br/leis/lei17900_2020.htm). Acesso em: 30 ago. 2024.
- Santa Catarina. *Lei Estadual n. 18.336, de 10 de janeiro de 2022*. Estabelece a logística reversa de medicamentos de uso humano ou veterinário, não utilizados ou com prazo de validade vencido. Diário Oficial do Estado, Florianópolis, SC, 11 jan. 2022(a). Disponível em: [https://www.legislacao.sc.gov.br/leis/lei18336\\_2022.htm](https://www.legislacao.sc.gov.br/leis/lei18336_2022.htm). Acesso em: 30 ago. 2024.
- Santa Catarina. *Lei Estadual n. 18.350, de 15 de fevereiro de 2022*. Define a política estadual de resíduos eletroeletrônicos, determinando a responsabilidade compartilhada pelo ciclo de vida desses produtos. Diário Oficial do Estado, Florianópolis, SC, 16 fev. 2022(b). Disponível em: [https://www.legislacao.sc.gov.br/leis/lei18350\\_2022.htm](https://www.legislacao.sc.gov.br/leis/lei18350_2022.htm). Acesso em: 30 ago. 2024.
- Santa Catarina. *Lei Estadual n. 18.442, de 20 de dezembro de 2022*. Estabelece diretrizes para a gestão de resíduos sólidos urbanos, incluindo a logística reversa de embalagens e produtos pós-consumo. Diário Oficial do Estado, Florianópolis, SC, 21 dez. 2022(c). Disponível em: [https://www.legislacao.sc.gov.br/leis/lei18442\\_2022.htm](https://www.legislacao.sc.gov.br/leis/lei18442_2022.htm). Acesso em: 30 ago. 2024.
- Sema. Secretaria Estadual do Meio Ambiente e Infraestrutura. *Portal Oficial*. Disponível em: <https://sema.rs.gov.br/quem-somos>. Acesso em: 26 out. 2024.
- Semae. Secretaria de Estado do Meio Ambiente e da Economia Verde. Minuta do decreto de sistemas de logística reversa em Santa Catarina (2024). Disponível em: <https://www.semoe.sc.gov.br/wp-content/uploads/2024/10/Minuta-do-Decreto-sistemas-de-Logistica-Revers-em-SC.pdf>. Acesso em: 13 fev. 2025.
- Serra, T. B. *Política de Resíduos Sólidos – Gestão econômica, responsável e ambientalmente adequada*. São Paulo: Ed. Verbatim, 2015, p. 132. Disponível em: <https://www.lexml.gov.br/urn/urn:lex:br:redde.virtual.bibliotecas:livro:2015;001083636>. Acesso em: 30 ago. 2024.



- Shumon, M.R.H., Ahmed, S. & Islam, M.T. Electronic waste: present status and future perspectives of sustainable management practices in Malaysia. *Environ Earth Sci* 72, 2239–2249 (2014). <https://doi.org/10.1007/s12665-014-3129-5>. Acesso em: 10 set. 2024.
- Silva, L. P.; Campos, T. C.; Mendes, A. F. O papel do licenciamento ambiental no fortalecimento da logística reversa no Brasil: uma análise do caso de São Paulo. *Revista Brasileira de Políticas Ambientais*, v. 17, n. 4, p. 150-165, 2023.
- Silva, M. J.; Azevedo, R. B. Logística reversa e sua aplicação no Brasil: uma análise da implementação da PNRS. *Revista Brasileira de Políticas Públicas*, v. 11, n. 1, p. 115-132, 2020.
- Silva, R. C.; Lima, F. A.; Pereira, T. F. Logística reversa na Política Nacional de Resíduos Sólidos: avanços e desafios. *Revista Brasileira de Políticas Públicas*, v. 10, n. 2, p. 259-277, 2020.
- Sinir. Sistema Nacional de Informações sobre a Gestão dos Resíduos Sólidos. Sobre o SINIR. Disponível em: <https://sinir.gov.br/informacoes/sobre/>. Acesso em: 23 mar. 2025.
- Suquizaqui, A. B. V.; Ventura, K. S. Desafios e oportunidades da logística reversa no Brasil: uma análise utilizando ferramentas de gestão. In: 2º CONRESOL, 2019, Foz do Iguaçu, PR. *Anais do 2º Congresso Sul-Americano de Resíduos Sólidos e Sustentabilidade*. São Paulo: IBEAS - Instituto Brasileiro de Estudos Ambientais, 2019. p. 1-9.