

**Solid waste management and contemporary challenges**

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## SUMMARY

In the present study we analyze and discuss socioenvironmental impacts arising from inadequate management of urban solid waste in the Brazilian Discovery Coast, southern Bahia. We also discuss the challenges to be overcome to promote proper management, highlighting the need for social inclusion of waste pickers. Methodological procedures consisted of an applied and exploratory research, through a review of specialized scientific literature. We also used secondary data available at the Brazilian Institute of Geography and Statistics and at the National Sanitation Information System, and applied a structured online questionnaire to municipal managers of public sanitation services. The cities under study only transfer the waste generated in urban centers to distant areas, in dumps, negatively affecting the environment and public health. There are neither management units nor incentive practices or support programs aimed at recyclable material collectors. Due to the weaknesses and the socioenvironmental, cultural, and historical importance of the area under study, the creation of public policies with broad popular participation is urgently needed to promote a fairer, healthier, and more sustainable development.

**KEYWORDS:** Socioenvironmental impacts. Discovery Coast. Social Inclusion of Waste Pickers.

## 1 INTRODUCTION

The growing generation and diversification of solid waste (SW) and its proper management are an obstacle to public management in most Brazilian cities. The current economic-technological development and changes in consumption habits make the destination and treatment of this waste a huge economic, environmental, and social challenge, especially in Brazil. This is because waste disposal in the country still occurs mostly irregularly, directly in the soil (Souza *et al.*, 2015; Zago and Barros, 2019; Costa and Dias, 2020; Yoshida, 2020; Vasconcelos, 2020).

The increase in pressure and concern for the mitigation and control of environmental impacts caused by this practice, mainly through legal norms and provisions, has considerably influenced municipal waste management practices (Singh, 2019). However, Zago and Barros (2019) state that the correct destination of SW has been neglected both by the government and by society.

Lack of waste generation control and its inadequate management are even more worrying in regions of relevant historical, environmental, cultural, and touristic importance. One example is the Discovery Coast, in Bahia State, which is one of the most frequented tourist regions in northeastern Brazil (BAHIA, 2016). This region comprises the main corridors of Atlantic Forest remnants in the national scenario (Amorim and Oliveira, 2013).

After nearly 21 years in the National Congress, Federal Law No. 12,305 was enacted on August 2, 2010, regulated by Decree No. 7.404 of December 23, 2010, instituting the National Solid Waste Policy (PNRS) (BRASIL, 2010). However, this action was not enough and many of the problems over this issue still persist. Given the mandatory closing of dumps and the promotion of environmentally correct management and disposal of waste, many cities are still irregular as they face financial, technical, and managerial difficulties to comply with these policies (Berríos, 2011; Marchi, 2015; Assad and Siqueira, 2016; Zago and Barros, 2019; Costa and Dias, 2020).

The adoption of measures for waste reduction and reuse and for the separation of recyclable materials at source is essential for an effective management of municipal solid waste (MSW). These measures bring important benefits such as social inclusion of waste pickers, reduction of waste to be forwarded for final disposal, energy saving, reduction of gaseous emissions, preservation of natural resources, and reduction of public health problems (Lino and Ismail, 2012; Al-Jarallah and Aleisa, 2014; Vasconcelos *et al.*, 2020). According to Oliveira and Medeiros (2019) and Costa and Dias (2020), these practices generate jobs as they add economic value to waste, with consequent generation of work and income and promotion of citizenship.

According to Zohoori and Ghani (2017), the following are indispensable elements for a management model: recognition of the various social agents involved; integration of technical, environmental, social, institutional, and political aspects, ensuring sustainability; consolidation and implementation of the legal basis through actions that promote its feasibility; financing mechanisms of the management structures; social control; and implementation of public policies for the sector, based on an integrated planning system.

Thus, focusing on the principles, guidelines, and goals brought by current legislation and its effects at the municipal level, this study addresses the reality of cities in the Brazilian Discovery Coast regarding the generation, control, and environmental management of MSW.

The study highlights the problems and challenges for meeting the PNRS and the social inclusion of waste pickers, contributing for society and municipal managers to cope with the difficulties faced by many Brazilian cities in managing solid waste (SW).

## **2 METHODS**

### **2.1 Study Site**

The Discovery Coast is located in the southern mesoregion of Bahia State, comprising eight cities, namely: Belmonte, Eunápolis, Guaratinga, Itabela, Itagimirim, Itapebi, Porto Seguro, and Santa Cruz Cabrália. The area has 12,118.31 km<sup>2</sup>, accounting for 2.14% of the territory of Bahia State (BAHIA, 2013). These cities are part of the Sustainable Development Consortium, created in 2013 by the Department of Urban Development of Bahia State – SEDUR with a multipurpose proposal.

According to IBGE, the population in the territory in 2019 was 381,727 inhabitants, which corresponds to 2.56% of the population of Bahia State. These estimates pointed to a demographic density of 236.12 inhab/km<sup>2</sup>. Porto Seguro (148,686 inhabitants) and Eunápolis (113,380 inhabitants) are the most populous of these municipalities, while Belmonte (23,328 inhabitants) and Itagimirim (6,869 inhabitants) are the smallest.

This Atlantic Forest region has rich biodiversity and ecosystems, including mangroves, restingas, lagoons, and beaches (BAHIA, 2013). It has an economy focused on commerce, tourism, livestock, industry, and agriculture, with forestry present in all cities through the cultivation of eucalyptus. Farmers in the region also emphasize the commercial production of coffee, coconut, and papaya. It is an important tourist region in northeastern Brazil, with this

sector generating the most jobs among the cities along the coast, especially in Porto Seguro and Santa Cruz Cabralia (BAHIA, 2016).

## **2.2 Data collection and analysis**

The methodology for the development of this work was divided into three stages. The first consisted of an exploratory survey of secondary data on MSW for the cities under study. These data were available in the database of the Brazilian Institute of Geography and Statistics (IBGE) and the National Sanitation Information System (SNIS). The Municipal Solid Waste Diagnosis, prepared by the Sustainable Development Consortium of the Discovery Coast – CONDESC (CONDESC, 2016), was used as a secondary source.

The second stage consisted of an applied and exploratory research of specialized scientific literature, reviewing the main journals. The selected articles should focus on solid waste, addressing the implementation of the PNRS, socioenvironmental impacts resulting from inadequate management, and the role of recyclable material collectors in this context.

The third and final stage consisted of preparing a structured questionnaire, in an online version. This was sent electronically to the agency responsible for the management and execution of public cleaning services in the eight cities under study. The structure of the questionnaire was divided into three sections, namely: 1) Management of public cleaning services; 2) Collection of MSW; and 3) Destination and final disposal of collected waste.

The importance of this analysis is in understanding the scientific view of researchers on the subject, thus diagnosing the problems raised in the cities of the Discovery Coast.

## **3 RESULTS AND DISCUSSION**

### **3.1 Generation and Management of Urban Solid Waste**

According to ABRELPE (2019), in 2018, MSW generation in Brazil reached 216,629 tons per day, totaling 79 million tons (mi/ton) of waste. This corresponds to an average *per capita* generation in Brazil and in its northeastern states of, respectively, 1.039 and 0.951 kg/inhabitant/day. Of the amount generated, the collection coverage rate reached 92%, of which only 59.5% were destined for sanitary landfills, with the rest being disposed of in dumps or inadequately controlled landfills in more than 3,000 Brazilian cities.

Table 1 shows the estimate of the amount of waste generated in the cities of the Brazilian Discovery Coast.

**Table 1 – Amount of waste generated in the cities of the Brazilian Discovery Coast.**

City	Population in 2019 (inhab.) <sup>1</sup>	Per capita generation (kg.inhab.day)	Waste generation (kg/day)
Belmonte	23,328	0.951	22,184.93
Eunápolis	113,380	0.951	107,824.38
Guaratinga	20,843	0.951	19,821.69
Itabela	30,584	0.951	29,085.38
Itagimirim	6,869	0.951	6,532.42
Itapebi	10,259	0.951	9,756.31
Porto Seguro	148,686	0.951	141,400.39
Santa Cruz Cabrália	27,778	0.951	26,416.88
<b>Total</b>	<b>381,727</b>	<b>-</b>	<b>363,022.38</b>

Source: Elaborated from IBGE and ABRELPE, 2019.

Note 1: Total population in 2019 obtained through the IBGE population projection.

Carvalho (2020) described an important seasonality in the daily *per capita* waste production in Porto Seguro city. In the low tourist season, the estimated average generation is 1.2 kg/inhabitant/day, with production of 150 ton/day. In the high tourist season, in turn, these values increase to 1.7 kg/inhabitant/day, with waste production of 212.5 ton/day. The annual average in the city is thus 181,250 tons per day. These data reveal an important increase in waste production due to tourist seasons, which occurs particularly in coastal cities. This poses an even greater challenge for public cleaning services in these cities.

The data collected from the questionnaire showed that, with the exception of Porto Seguro, no city has prepared a Municipal (or Regional) Solid Waste Plan, which is a mandatory item according to the PNRS. In addition, the agencies responsible for public cleaning services are inefficient, with the management of MSW restricted solely to its collection and removal from urban areas, without any previous segregation procedure, differentiated destination, or treatment.

There are neither treatment units nor proper disposal for the collected MSW, with the occurrence of irregular disposal in open dumps, as shown in Box 1.

**Box 1 – Information on the management and handling of MSW.**

City	Agent in charge	Collection coverage in the urban area (%)	Final disposal unit	Covering of disposed waste	Presence of waste pickers at the dump
Belmonte	Public	100	Dump	nonexistent	yes
Eunápolis	Public	100	Dump	nonexistent	yes
Guaratinga	Public	100	Dump	nonexistent	yes
Itabela	Public	100	Dump	nonexistent	yes
Itagimirim	Public	100	Dump	nonexistent	yes
Itapebi	Public	100	Dump	nonexistent	yes
Porto Seguro	Public	100	Dump	nonexistent	yes
Santa Cruz Cabrália	Public	100	Dump	nonexistent	yes

Source: Elaborated by the author.

All cities had recyclable material collectors in both the urban areas and final disposal sites, these being the only actors in terms of segregation, reuse, and recycling of MSW. The inexistence of actions, programs, or other forms of incentive on the part of the government hinders the activity of these professionals who work mainly in the areas of municipal dumps, in

which completely degrading and unhealthy work conditions lead to inefficiency in the collection. Only the cities of Porto Seguro and Eunápolis have a duly established cooperative of waste pickers. However, lack of support from the public or even private authorities prevents or limits dignity at work and an adequate income for these workers.

### **3.2 Socioenvironmental aspects and impacts of MSW**

Despite the progress in the development of public policies for solid waste (SW), municipal managers largely delay their compliance, maintaining the irregular arrangement and generating negative consequences for the environment and public health (Garcia and Candiani, 2017; Maiello *et al.*, 2018; Araújo *et al.*, 2019; Carvalho, 2020). As mentioned by Carvalho (2020), the difficulties faced by municipal managers led to the approval of Bill No. 2,289/2015, which extended the deadline established by the PNR for the closure of landfills from 2014 to 2021. The Bill was ratified by Law No. 14,026/2020, which instituted the New Basic Sanitation Framework.

In addition to being a source of disease to the population and a source of proliferation of urban pests, the gases from the decomposition of the organic fraction of MSW contaminate the air. Moreover, the leachate generated contaminates the soil and can reach the water table, polluting groundwater and thus harming public health and the environment (Siqueira and Moraes, 2009; Gouveia, 2012; Singh, 2019; Zago and Barros, 2019). It is noteworthy that the impacts of this degradation extend beyond the final waste disposal areas, affecting the population and closest ecosystems. Thus, it is also necessary to consider the potential of ecosystem services needed to degrade the disposed waste (Jacobi and Bensen, 2011; Holzman, 2012).

According to Siqueira and Moraes (2009) and Vasconcelos *et al.* (2020), the emergence of waste pickers is a consequence of the immense social and economic inequality that occurs in Brazil. The authors further state that it also has to do with current consumption patterns that generate more and more waste, where people with no education and with little or no professional qualification are subject to living on what others discard.

Siqueira and Moraes (2009) show that waste pickers who work in dumps are the most vulnerable to work accidents. Among these accidents stand out cuts, dermatitis, respiratory diseases, parasitic diseases, exposure to chemical and biological products, animal bites, and food poisoning.

In addition to being an important instrument for the efficient management of MSW and for minimizing social and environmental impacts, selective collection can effectively contribute to the generation of employment and income. When well structured, it can add market value to SW and promote the social inclusion of recyclable and reusable material collectors, as pointed out by Euzébio (2018). This author also states that the proper selection of materials increases the gains for collectors and reduces the risks to public health and the environment, also reducing the extraction of natural resources in the form of raw materials.

The Brazilian Institute of Applied Economic Research (IPEA, 2010) corroborates this finding. According to this institute, the processing of all recycled waste could economically

benefit the Brazilian society at R\$ 8 billion per year, a value much higher than the current collections in the order of R\$ 1.4 billion and R\$ 3.3 billion per year.

### **3.3 Challenges for solid waste management with social inclusion**

The capacity of cities to promote adequate MSW management is the biggest obstacle to complying with the terms of Federal Law No. 12,305/2010. Despite being in force since August 2010, this law did not result in any change in the management and handling of MSW in the cities of the Brazilian Discovery Coast, all of which are in default of compliance.

Municipal administrations are aware of the noncompliance with the aforementioned legislation and its legal and criminal consequences. Notwithstanding, they still maintain irregular practices of final disposal, without any observance and respect for the terms provided for in the law. Likewise, there are no programs, campaigns, or actions aimed at raising awareness among the population about solid waste, as well as there is no support or any incentive to the activity of existing waste pickers, which demonstrates a lack of interest of municipal administrations in this regard.

The PNRS highlights integrated management as: “[...] a set of actions aimed at finding solutions for solid waste, considering the political, economic, environmental, cultural, and social dimensions, with social control and under the premise of sustainable development [...]” (BRASIL, 2010, Art. 3, XI). This definition highlights the multidimensional character of aspects related to waste, understood as a broad and complex theme.

The promotion of integrated and participatory management must be implemented through regional analysis, relying on principles that allow the development of appropriate and compatible solutions at the local level (Vergara and Tchobanoglous, 2012). This approach opposes the paradigm currently in force in USW management, characterized by treating the problem in a sectorial, disjointed way, obstructing a systemic view of the problem and reflecting fragmented and often inefficient public policies (Zohoori and Ghani, 2017).

Therefore, the challenges to be overcome to comply with the terms established by the law include: limitations of an institutional and administrative nature; lack of technical and trained staff; budget restrictions or financial limitations; lack of environmental education programs; low involvement of society with the issue of MSW, and discontinuity of political management (Maiello *et al.*, 2018; Zambon, 2019). This situation is even worse in the Discovery Coast since it is a region with an important tourist flow, with a considerable increase in waste production in high seasons (Carvalho, 2020).

One of the many objectives brought by the PNRS is the universalization of public urban cleaning services, which is one of its fundamental principles (BRASIL, 2010, Art. 7, X). However, according to Zago and Barros (2019), the universalization of waste management must include the management of SW from collection to treatment and final destination. For this to be possible, considering also other goals provided for in the aforementioned Law, investments in the order of R\$ 11.6 billion by 2031 would be necessary, added to the R\$ 15.59 billion per year, to fund the operation and maintenance of structures and systems that would be built (ABRELPE, 2019).

As for social inclusion, the results showed that carrying out selective collection in the cities is already a challenge, as it has been occurring in an insufficient and unsatisfactory way. The PNRS portrays waste pickers as the protagonists of selective collection, and encourages partnerships with associations or cooperatives to promote social inclusion. However, even with the aforementioned law recognizing these professionals as fundamental in waste management and guaranteeing improvements in their working conditions, it does not address labor, health, or human dignity aspects related to this category, only generically explaining its economic inclusion in the process (Gouveia, 2012; Zambon, 2019; Vasconcelos, 2020).

Furthermore, although many municipal managers have a concern and urgency to close dumps, it is necessary to relocate and include the waste pickers that exist there. The definition of a strategy and project for the continuity of work and maintenance of the income of these workers must take place before the deactivation of irregular waste deposits.

In the current scenario, Zambon (2019) emphasizes that the promotion of MSW management in Brazil is not restricted to environmental and public health problems, as it also involves citizenship, social, safety, work, and sustainability issues. Therefore, the institutional and structural problems of Brazilian society, as observed in the cities of the Discovery Coast, go beyond those of a technical, economic, normative, or technological nature.

One of the viable possibilities encouraged by the PNRS itself to overcome all the difficulties reported here is the formation of intermunicipal public consortia. Although its implementation faces many difficulties due to discontinuities in municipal management and lack of technical and administrative support from cities, it is still considered the main instrument through which cities can achieve full compliance with the terms established by the PNRS (Milanez and Massukado, 2012; Zohoori and Ghani, 2017; Costa and Dias, 2020).

As mentioned above, the cities of the Brazilian Discovery Coast are already part of a multipurpose consortium, the CONDESC. Therefore, it is necessary a union and dialogue between municipal public managers so as to promote the actions and measures necessary to comply with Law No. 12,305/2010. This will imply environmental preservation of ecosystems, environmental recovery of degraded areas, protection of public health and, obligatorily, social inclusion of existing waste pickers, providing them with security, income, and dignity at work.

#### **4 CONCLUSION**

This article uncovered the aspects of MSW management in the Brazilian Discovery Coast from the perspective of compliance with the 2010 PNRS, focusing on the social inclusion of waste pickers. The cities under study continue to dispose of their MSW in an inadequate way from a legal, sanitary, and environmental point of view. This puts public health and the quality of natural resources at risk, with negative impacts on cities. These impacts are more evident in those professionals who subsist on waste, i.e., waste pickers.

The enactment of the PNRS in 2010 was not enough to promote any mobilization or change in inadequate solid waste management in the cities under study. This scenario perpetuates an irregular disposal of more than 363 tons of waste without any type of treatment in southern Bahia. This demonstrates a lack of capacity, or interest, to comply with the legal terms that must be regularized under the New Sanitation Framework.



Although the PNRS is comprehensive and robust, compliance with its terms at the municipal level requires multidisciplinary discussions with the participation of all sectors of society. Policies in this regard must necessarily integrate the economic, social, public health, and environmental spheres. Most of all, they must be elaborated with intense popular participation, requiring the engagement of civil society and inspection agencies for the proper fulfillment of the law.

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