

# Characterization of solid waste from the beaches of Itapuã, Stella Maris and Flamengo in Salvador/Bahia/Brazil

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**Abstract**—The disposal of solid waste in the sand strips of the beaches tends to cause environmental, social, economic and public security damages. This can lead to risks of contamination by infectious diseases and a demotivating look at the natural wealth of the marine environment. In this way, this work aimed to characterize the solid residues of the beaches of Itapuã, Stella Maris and Praia of Flamengo, aiming to provide subsidies for Environmental Education campaigns, in order to sensitize the population. This research is of qualitative and quantitative nature, being also exploratory and of field. The survey results indicated that the most representative classes found on the three study beaches were plastic and wood, followed by non-recyclable waste. The cigarette filters were classified as not recycled and were expressive in numbers of the category in quantity in the three beaches. In this way, the significant amount of solid waste on Itapuã beach can be attributed to its geographical location with easy accessibility to its regulars and traders, in addition to the quality of the water for bathing, low level of turbidity of the waters and small height of waves.

**Keywords**—Beaches, Environmental education, Solid waste.

## I. INTRODUCTION

The Brazilian coastal zone comprises a strip of 8,698 km in length and variable width facing the Atlantic Ocean (ACUÑA, 2017), while the city of Salvador comprises a coastal zone with a strip of 50 km in length and 23 beautiful bathed beaches through the waters of Todosos Santos Bay (DUTRA, 2008 apud FREITAS, 2016).

However, the environmental quality of these beaches after use is threatened due to the disposal of solid waste left by the population (residents, stallholders, bathers, tourists and street vendors) that end up polluting and causing negative impacts to the marine environment and tend to

cause damage of order environmental, social, economic and public security (SANTANA-NETO et al., 2011).

Marine solid waste is of anthropogenic origin introduced by urban drainage, beach users, boats and platforms, being subdivided into classes such as plastic, paper, metal, glass, organic material, wood and non-recyclable waste, and consisting mainly of material little degradable or non-degradable, which inevitably accumulates in the environment can cause major problems (ORTIZ, 2010).

The presence of solid residues found in coastal and marine environments, in addition to polluting the sand and coastal waters, causing the risk of contamination by skin

diseases and other diseases, creates an unpleasant visual effect, diminishing the scenic beauty of the beaches and demotivating the presence of tourists (SOUZA; SILVA, 2015).

This type of pollution can compromise the quality of coastal and marine ecosystems, changing the life of microorganisms and sand microfauna, as well as attracting the presence of disease-transmitting animals, such as rats, pigeons and vultures (SOUZA; SILVA, 2015).

The characterization of solid waste arising from inadequate disposal on the beaches of Itapuã, Stella Maris and Praia do Flamengo, will have socio-environmental relevance, since, after identification, they will provide subsidies for Environmental Education campaigns, in order to raise awareness among the local population (residents and tents) and floating (bathers, tourists and street vendors) of the importance of correct disposal to minimize present and future environmental, social, economic and public safety losses.

In this way, this work aimed to characterize the solid residues of the beaches of Itapuã, Stella Maris and Praia do Flamengo, aiming to provide subsidies for Environmental Education campaigns, in order to raise awareness and make the population sensitive to environmental issues. In this sense, this research is of a qualitative and quantitative nature, being also exploratory and field.

Based on the bibliographic surveys, we can observe the interest of studies carried out by the scientific community on marine solid waste on the beaches of the Northeast, with emphasis on the works carried out by Caldas (2007); Souza; Silva (2015); Santana Neto et al., (2011); Santana Neto (2009); Brito (2014); Barros et al., (2012); Santiago

et al., (2012); Araújo (2003); Lime; Silva (2016), Silva et al., (2009), and others in the southeast region by Santos; Bonetti (2018); Martins et al., (2010); Leite et al., (2011); Ferreira; Ramires (2017); Fernandinho (2012); Farias (2014); Ortiz (2010); Neves et al., (2011); Silva et al., (2018); Bruno; Santos (2012).

Thus, the results found indicate that the most representative classes found in the three study beaches were plastic and wood, followed by non-recyclable waste. Cigarette filters were classified in the non-recycled class and were expressive in numbers of the category in quantity in the three beaches.

Therefore, the expressive amount of solid waste on the beach of Itapuã is attributed to its geographical location in the capital of Bahia with easy accessibility to its regulars and traders, in addition to the quality of the water for bathing, low level of turbidity of the water and small height of waves. Furthermore, the high levels of the plastic waste class, such as disposable cups, straws and their packaging, the non-recyclable waste class, such as cigarette filters, and the wood class, such as barbecue and popsicle sticks, are associated with products frequently sold on the beaches by street vendors.

## II. MATERIALS AND METHODS

### 2.1 STUDY AREA

This study was carried out on the beaches of Itapuã with Latitude: 12 ° 57'2.86 "S and Longitude 38 ° 22'0.86" O; Stella Maris with Latitude 12 ° 56'52.40 "S and Longitude 38 ° 20'23.34" O and beach of Flamengo with Latitude: 12 ° 55'18.97 "S and Longitude: 38 ° 18'45.84" O (Fig. 1).



Fig.1: Location of beaches and collection points

Source: Jambeiro (2019)

## 2.2 SAMPLING

The collections took place in February 2019 on the beaches of Itapuã (Fig. 2), then the beach of Stella Maris and ending on the beach of Flamengo, obeying a 3-hour workload during the day shift through the scanning method at foot parallel to the sea line, covering a certain area of the beach around 1 km from each one, allowing better displacement and visualization of the solid residues found (MARIANO, 2000 apud CALDAS, 2007).



Fig.2: Collection of solid waste in February 2019 at beach of Itapuã, Salvador/BA.

Source: Jambeiro (2019)

The collected residues were separated and qualified and qualified in loco (Fig. 3) using the collection form, being subdivided into classes such as plastic, paper, metal, glass, organic matter, wood and non-recyclable waste

according to CONAMA Resolution No. 275, of April 25, 2001. That resolution establishes the color code for the different types of waste to be adopted in the identification by collectors and transporters, as well as in information campaigns for selective collection. After this qualification process, the residues were quantified by units in each class, which were again bagged and transported for weighing and ending with the appropriate destination.



Fig.3: qualification of waste in loco at Itapuã beach, Salvador/BA.

Source: Jambeiro (2019)

## III. RESULTS AND DISCUSSIONS

A total of 4,840 kg were collected, with a greater amount of solid waste found on Itapuã beach with 2,820 kg (58,26%), followed by Stella Maris beach 1,820 kg (24,38%) and Flamengo beach 0,840g (17, 2%) (Table 1, 2 and 3).

Table 1: Classification and quantification of solid waste collected at Itapuã beach, Salvador, BA, Feb. 2019

BEACH	CLASS	WASTE	AMOUNT	TOTAL WEIGHT	% WEIGHT
ITAPUÃ	PLASTIC	PET BOTTLE COVER	45	2,82 Kg	58,26
		PLASTIC CUP	56		
		CANUDES	49		
		CUTLERY	33		
		LOLLIPOP STICKS	6		
		BAGS	4		
		PICOLE PACKING	13		
		BRASS	3		
		CHICLET PACKING	8		
		FRAGMENTS	48		
	TOTAL PLASTIC		265		

	METAL	BEER SEALS	9		
		BEER COVERS	17		
		BEER PROTECTOR SEAL	77		
		DANONE PACKING	1		
		FRAGMENTS	1		
	TOTAL METAL		105		
	WOOD	BARBECUE STICK	126		
		POPSICLE STICK	148		
		CLOTHING PREACHER	1		
	TOTAL WOOD		275		
	ORGANICS	REST OF FOOD (BONES)	1		
	TOTAL ORGANICS		1		
		CIGARETTE PORTFOLIO	1		
	NON-RECYCLABLE WASTE	CIGARETTE FILTER	63		
		BLOWING BALL	3		
		CONDOM	1		
		ISOPOR FRAGMENT	1		
	TOTAL NON-RECYCLABLE		69		

Source: Jambeiro (2019)

Table 2: Classification and quantification of solid waste collected at Stella Maris beach, Salvador/BA, Feb. 2019

BEACH	CLASS	WASTE	AMONT	TOTAL WEIGHT	% WEIGHT
STELLA MARIS	PLASTIC	PET BOTTLE COVER	17	1,18 Kg	24,38
		PLASTIC CUP	15		
		CANUDES	29		
		CUTLERY	11		
		LOLLIPOP STICKS	6		
		BAGS	3		
		PICOLE PACKING	5		
		BULLET PACKING	5		
		BEER PACKING	8		
		CANUDO PACKING	33		
		MINERAL WATER LABEL	1		

		FRAGMENTS	34		
		PET BOTTLE COVER	17		
	TOTAL PLÁSTIC		161		
	PAPER	FLYERS	3		
		NAPKIN	14		
		PACKING OF PEANUTS	5		
		FRAGMENTS	5		
	TOTAL PAPER		27		
	METAL	BEER SEALS	7		
		BEER COVERS	11		
		BEER PROTECTOR SEAL	21		
		FRAGMENTS	1		
	TOTAL METAL		40		
	WOOD	BARBECUE STICK	19		
		POPSICLE STICK	28		
		CHAMPAGNE STOPPER	1		
		CLOTHING PREACHER	1		
		TOOTHPICK	1		
	TOTAL WOOD		50		
	ORGÂNICS	REST OF FOOD (BONES)	2		
	TOTAL ORGANIC		2		
	NON-RECYCLABLE WASTE	PORTIFOLIO CIGARETTE	1		
		CIGARETTE FILTER	157		
		MONEY RUBBER	1		
		ISOPOR MARMITEX	1		
	TOTAL NON-RECYCLABLE		160		

Source: Jambeiro (2019)

Table 3: Classification and quantification of solid waste collected at Flamengo beach, Salvador, BA, Feb. 2019

BEACH	CLASS	WASTE	AMONT	TOTAL WEIGHT	% WEIGHT
FLAMENGO	PLASTIC	PET BOTTLE COVER	3	0,84 g	17,2
		PLASTIC CUP	28		
		CANUDES	18		
		CUTLERY	2		



		BAGS	5		
		PICOLE PACKING	5		
		PACKAGE OF SNACKS	1		
		CANUDO PACKING	12		
		REFRIGERANT LABEL	2		
		FRAGMENTS	5		
	TOTAL PLASTIC		81		
	PAPER	NAPKIN	12		
		BEER LABEL	4		
		PAPER FRAGMENTS	10		
	TOTAL PAPER		26		
	METAL	BEER COVERS	11		
		FRAGMENTS	1		
	TOTAL METAL		12		
	WOOD	BARBECUE STICK	7		
		POPSICLE STICK	8		
		CHAMPAGNE STOPPER	1		
	TOTAL WOOD		13		
	ORGANICS	FLOWER	1		
	TOTAL ORGANIC		1		
	NON-RECYCLÁBLE WASTE	CIGARETTE FILTER	32		
		ISOPOR MARMITEX	3		
		TISSUE FRAGMENTS	2		
	TOTAL NON- RECYCLÁBLE		37		
	Source: Jambeiro (2019)				

The results obtained show a high value of solid residues present at Itapuã beach (715 units), followed by Stella Maris (440 units) and beach of Flamengo (170 units) (Fig. 4). This high value of urban waste collected on the beach of Itapuã may be related because it is in an urbanized environment with houses, inns, hotels, restaurants and beach huts and many street vendors on the sand strip, facilitating the availability of public transportation on site.

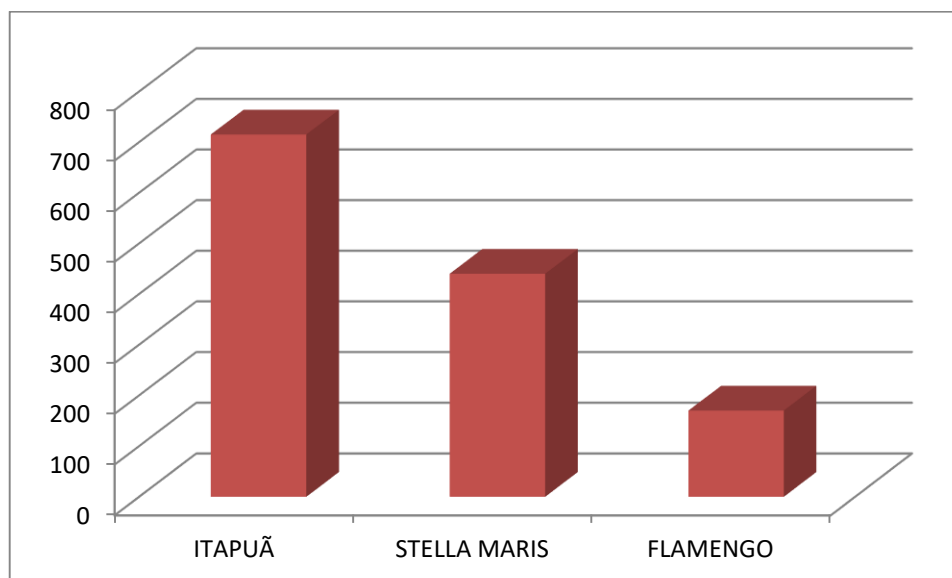


Fig.4: General quantity in units of waste collected on the beaches in Salvador , BA, Feb. 2019

Source: Jambeiro (2019)

Another important and positive fact was highlighted in the work developed by Silva et al., (2009), which are the characteristics of the coastal zone that Itapuã beach presents as the good quality of the water for bathing, low level of turbidity of the waters and small height of waves. On the other hand, the Urban Cleaning Company - LIMPURB also responsible for coordinating the cleaning and ordering teams on the coastal strip in Salvador listed Itapuã beach in 2017 as one of the beaches where the

greatest amount of solid waste is usually removed in the month of February.

As for the classes: plastic, paper, metal, glass, organic matter, wood and non-recyclable waste, plastic stands out as the most representative with 507 units, followed by wood with 388 units, non-recyclable with 266 units and metals with 157 , the other classes such as paper and organics collected were represented by numbers below 100 units (Fig. 4).

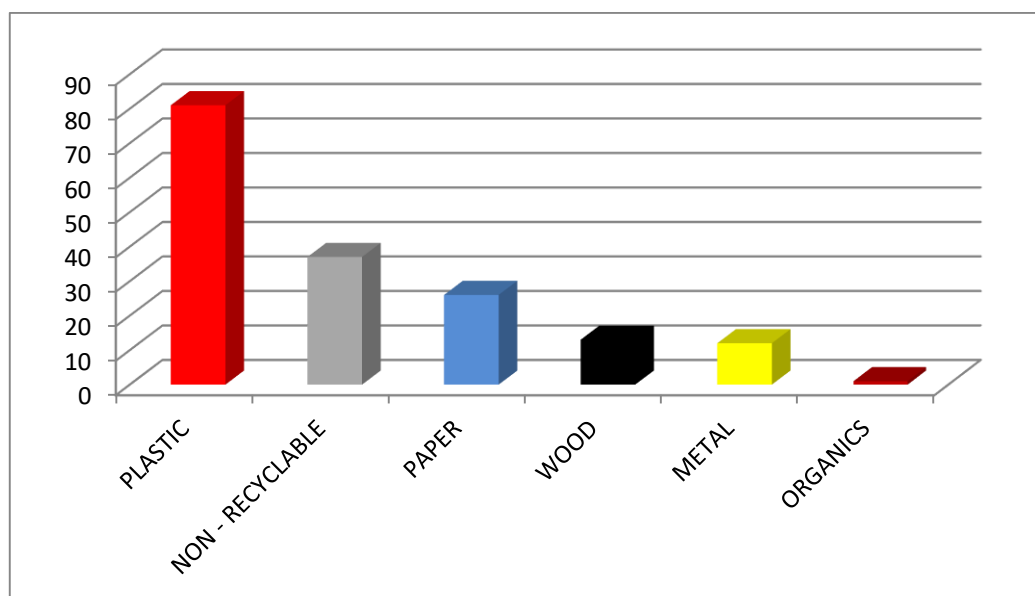


Fig.4: General graph of waste classified by classes collected on the beaches of Itapuã, Stella Maris and Flamengo, Salvador , BA, Feb. 2019

Source: Jambeiro (2019)

Plastic and wood residues, followed by non-recyclable residues, were found in greater quantities, similar to the works carried out by Caldas (2007); Santana Neto (2009) and Brito (2014) also on the beaches of Salvador - BA.

Among the classes of waste characterized as glass, it was the only class not found on the three beaches, corroborating the similarity of the work of Cerqueira (2015) carried out on the beach of Itapuã, Salvador - BA.

Waste of the non-recyclable class totaling 266 units collected, with 252 units being cigarette filters, which correspond to 94.73% collected. The large quantity of cigarette filters was also cited in the works carried out by Santos and Bonetti (2018) in São Paulo on the beach of Guaratubá and, in Salvador, on the beach of Porto of Barra, authored by Santana Neto (2009).

#### IV. CONCLUSION

The results obtained indicate that the beaches have high tourist and recreational potential due to the easy access to several communities in Salvador, metropolitan region and proximity to the International Airport of the capital and, therefore, a tourist attraction in which factors that collaborate in the significant quantification of waste and in diversification as to their classes. Therefore, visitors to the three beaches studied have a behavior in which, after use, they do not collect the waste generated, disregarding the care with the preservation of the environment.

Thus, the high levels of the class of plastic waste such as disposable cups, straws and their packaging, the class of non-recyclable waste such as cigarette filters and the wooden class such as barbecue and popsicle sticks are associated with products often sold on the beaches. by street vendors. Among the most commonly found materials associated with human consumption are cigarette filters (252 units), popsicle sticks (184 units), barbecue sticks (152 units), disposable cups (99 units), straws (96 units) and lids. pet bottle (65 units).

Given the above, it is necessary to intensify awareness campaigns with the support of the principles of environmental education in neighborhoods and streets close to the beaches through frequent dialogues with the local population (residents and tent workers) and floating (bathers, tourists and street vendors). Other tools would be easily accessible advertising campaigns and social media as technological resources showing the importance of not generating waste, conscious consumption and correct disposal of products consumed on the beaches.

In addition to the participation of the population, it is also of fundamental importance to take as a starting point

the actions promoted by public management in the management and correct disposal of waste collected in the capital of Bahia, especially on the seafloor, since activities aimed only at cleaning the place do not have guaranteed the partnership with the employees of the recycling services of the collected products.

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