

Solid Waste Generated by Amazon and Tapajós River Vessels: An Environmental Education Activity

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Abstract

Given the lack of research on solid waste generated by vessels and often incorrectly discarded, it became clear the need for a new methodological approach focusing on the knowledge of this theme. Thus this study was conducted focusing on the process of awareness of users of a vessel that made the route that traveled the Amazon River and Tapajós, using an environmental awareness activity, with results and immediate observations. From this, the waste was quantified before and after the interventions, which occurred from the clarification of the environment, solid waste generation, natural resources, water, among others. The research took place aboard a vessel that connects Manaus-AM to Alenquer-PA, evaluating the before and after the intervention. Given this, it is verified that the evaluation process achieved positive results in the minimization of solid waste generated, ensuring that the study has immediate effect, but the intervention measures need time for consolidation, given the responsibility of environmental education, which needs different approaches, under different eyes and with depth of knowledge, even if it requires a long-term process. Therefore, the importance of this type of activity is verified, aiming at the correct destination of the solid waste generated, in any circumstance, mainly in vessels, in different rivers, considering the condition of this natural resource. In addition, user awareness and education through environmental education is mandatory to better understand the impacts caused by different changes over time and needs to be an effective tool to ensure the success of habit transformation processes and quality improvement of life.

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Published Date: 11/30/2019

Page:397-404

Vol 7 No 11 2019

DOI: <https://doi.org/10.31686/ijer.Vol7.Iss11.1893>

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Abstract

Given the lack of research on solid waste generated by vessels and often incorrectly discarded, it became clear the need for a new methodological approach focusing on the knowledge of this theme. Thus this study was conducted focusing on the process of awareness of users of a vessel that made the route that traveled the Amazon River and Tapajós, using an environmental awareness activity, with results and immediate observations. From this, the waste was quantified before and after the interventions, which occurred from the clarification of the environment, solid waste generation, natural resources, water, among others. The research took place aboard a vessel that connects Manaus-AM to Alenquer-PA, evaluating the before and after the intervention. Given this, it is verified that the evaluation process achieved positive results in the minimization of solid waste generated, ensuring that the study has immediate effect, but the intervention measures need time for consolidation, given the responsibility of environmental education, which needs different approaches, under different eyes and with depth of knowledge, even if it requires a long-term process. Therefore, the importance of this type of activity is verified, aiming at the correct destination of the solid waste generated, in any circumstance, mainly in vessels, in different rivers, considering the condition of this natural resource. In addition, user awareness

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1. Introduction

The waterway modal has always stood out in the transport sector in the north of the country, even presenting itself as a major driver of international trade. As a result, the globalization of markets and the intensification of international transactions over the last 30 years have boosted the flow of goods and boosted the expansion of the port sector, which in turn has proved to be a more appropriate alternative, given the possibility of from larger displacements, with lower associated costs, compared to land or air transport, for intercontinental travel.

[1] says that managing the environment in the port area is a complex challenge that involves many levels of knowledge. Most of our port environmental managers, when they exist, do not have an operational, environmental or even social framework appropriate for the implementation of appropriate management models in an environment marked by the complexity of the processes.

Also in the context of port environmental management, in which one aspect is highlighted through the management of waste, which is still ineffective, whether operational, vessel or cargo aspects.

Although specifically ship-generated waste is subject to international regulations, such as the International Convention for the Prevention of Pollution from Ships - MARPOL 73/78 Convention [2] and the International Organizing Maritime (IMO) Regulations [3], there is still little effectiveness under stricter conditions.

Given the above, we have the UN specialized agency, responsible for the safety of navigation and prevention of maritime pollution caused by ships, where developed countries have been implementing their own policies through regulations and proactive initiatives by sectoral entities and port authorities.

According to [4], the residues of vessels and residues from port activities are pointed as one of the main factors that cause the impact of the activity. However, the implementation of proper waste management in face of regulations on the subject is still a factor to be improved.

Water pollution by solid waste has been growing every year. In general, these are dumped mainly by people who in boat trips made in the State of Amazonas, especially in those municipalities with greater tourist potential such as Parintins, Maués, Barcelos, among others.

It is noteworthy that although some boats maintain a collection system, many passengers are not aware of these issues and end up dumping these wastes directly into the rivers.

This situation is especially aggravated during the holiday season, as it considerably increases the number of boats. Part of the non-biodegradable "waste" submerges and the other part goes to the beaches harming the floodplain agriculture and even the ecotourism process. Although this aquatic waste is mostly made of chemically neutral materials, what causes concern is the decomposition and sedimentation that is occurring in the riverbed and in particular in the floodplain areas, changing the normal conditions of this environment, with repercussions. unpredictable for the fauna [5].

In Brazil, the process of most intense urbanization began from the 1960s, but in the Amazon, the intensity began to occur only 20 years later. Today, most people live in cities where about 70% of the population lives in urban centers, which demystifies the image of a depopulated and strictly rural Amazon [6]. With the increase of small urban agglomerations and the emergence of medium-sized cities in the Legal Amazon, the weaknesses of an urban network were revealed that are related to the impediment of the flow of people, goods and services, highlighting the great distances, the lack of infrastructure in the cities. transport and communication sectors and material and educational resources [7].

Belém and Manaus, two major cities in the Region, have been losing out in terms of urban population to medium-sized cities, a phenomenon that occurs throughout Brazil, showing a deconcentration of the urban area of these cities to increasing urbanization of medium and small cities [6].

According to [8], the urban environment characterized by high demographic density, unbridled generation of solid waste, modification of biodiversity, removal of native forest, soil impermeability, among others, generate a set of environmental problems such as water pollution, occupation river banks, lack of basic sanitation and pollution of the whole sphere.

Another characteristic of urban space is the consumption and production pattern that surpasses the regeneration capacity of natural systems verified in urbanization processes, with great demand for food, transportation, housing, energy and comfort, aiming at meeting human needs in life. modern [8].

In this sense, river navigation is responsible for the flow of production and locomotion, allowing the survival of several municipalities, towns and other production centers, in addition to the development of the Amazon, where river transport in many locations is solely responsible for trade and transportation. displacement of people [9].

The Amazonian waterway system, the largest in Brazil, is made up of the Solimões-Amazonas Waterway, the Madeira Waterway and the Tapajós Waterway. The main navigable rivers are: the 1,620 km Solimões River, the 1,508 km Amazon River, the 2,449 km Purús River, the 310 km Negro River, the 398 km Rio Branco and the 110 km Jari and Trombetas Rivers each, the 1,052 km Madeira River, the 212 km Aripuanã River and the 345 km Tapajós River. These waterways with about 80% of the economically navigable inland waterways in Brazil, 36% are used to transport passengers and cargo, called mixed vessels [10].

Therefore, river transportation in the Amazon was fundamental in the late nineteenth century for the rubber cycle, which generated economic interests of private groups in the exploration and introduction of new ships, since the monopoly of the Grão-Pará Trade Company Maranhão, with the objective of developing agriculture and commerce, having a considerable fleet of ships, including warships [10].

Even today many river craft are built by hand (informal), through knowledge acquired from masters in shipbuilding, in which they were directly linked to the nineteenth century shipyards, when they made medium and small boats, called “boats”. “inline and pleasure engines”, taking advantage of the entire model and architecture of the larger overseas vessels, particularly the United States and Europe [11].

In the Amazon Region, passenger and cargo waterway transportation is carried out by inland waterways. According to [4], its study counted 602 vessels in 317 regular lines. One of the main lines connects the two main capitals of the Northern Region (Belém / PA and Manaus / AM) with 1,642 km away. The number of passengers using waterway transport in the Region is approximately nine million per year.

Through the exposure presented, the aim of this study was to quantify the solid waste of a large vessel that

navigates between the Amazon and Tapajós rivers (AM-PA), implementing environmental education from an immediate and effective approach to the generation of environmental awareness.

2. Materials and Method

2.1 Study area

The study was conducted in the waterway mode between the Amazon (Amazonas) and Tapajós (Pará) Rivers (Figure 1).

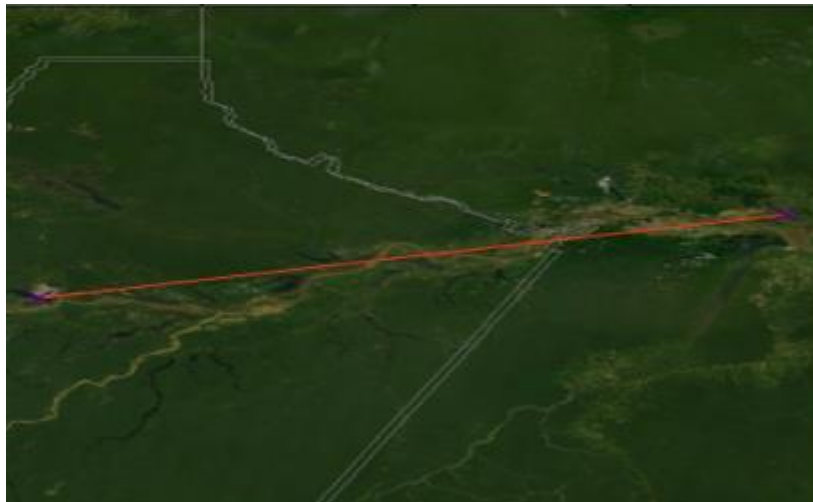


Figure 1 - Map of the vessel's trajectory location for collecting waste data.

Source: Thiago Fernandes (2019).

The climate of the Region is characterized by humid tropical, whose air temperature varies between 24°C and 26°C. The average annual rainfall is 2205 mm higher than the average of all basins in Brazil - 1,761 mm. The average flow in the Amazon basin is 132,145 m³ / s and a water availability of 73,748 m³ / s [12]. The type of approach adopted in the research occurred through the quantitative exploratory method. According to [13], by adopting an exploratory and descriptive approach, the researcher should be open to their findings. Even if you start the work from some theoretical scheme, the researcher should be alert to new elements or dimensions that may arise during the work.

The present activity can be classified, in a case study, using a vessel, in depth character. The Monte Cristo ferry boat, one of the largest waterway transports, bound for the municipality of Alenquer-PA, with representation in its respective cargo and passenger transport segment, where waste was measured and classified before and after an activity. environmental.

The environmental approach to encourage users and crew sought, based on the concept of environmental education and aiming at environmental awareness, on board in the waterway mode, to instrumentalize reflection, seeking to observe behavioral change, thus obtaining the representativeness of sustainable development and preservation of the environment. Thus, a proposal for a lecture on environmental education was made during the trip, seeking results that immediately described the intervention process.

In the quantitative analysis, the study provided four separate collection bins for segregation of the collection of solid waste generated on the vessel, placed in the upper wagon where most passengers are located. The

total amount of waste generated by a 50 kg precision scale was measured using plastic gloves to handle the contaminated material and 50 l plastic bags.

Between one collection and another, an intermediation was presented through a short explanation about environmental education. It should be emphasized that the weighings were performed before and after the educational approach, in order to observe a small change in the conception and sensitization of the information, in order to constitute, in fact, the waste collection information, seeking from a specific condition. indicate the completion of this activity.

3. Results and Discussion

The purpose of the evaluation process is to observe the results seeking to infer about the minimization of solid waste generated by the vessel's users and crew, and to ensure that the study initially led to a sensitization process; and long-term awareness of vessel users about their role in reducing, mitigating or not disposing of waste incorrectly.

In this context, an intervention lecture was given to highlight the environmental awareness theme and its impacts on the rivers. Therefore, it is extremely important to deepen the real situation of how the generation and disposal of waste occurs, obtaining positive effects immediately through this intermediation (Figure 2).

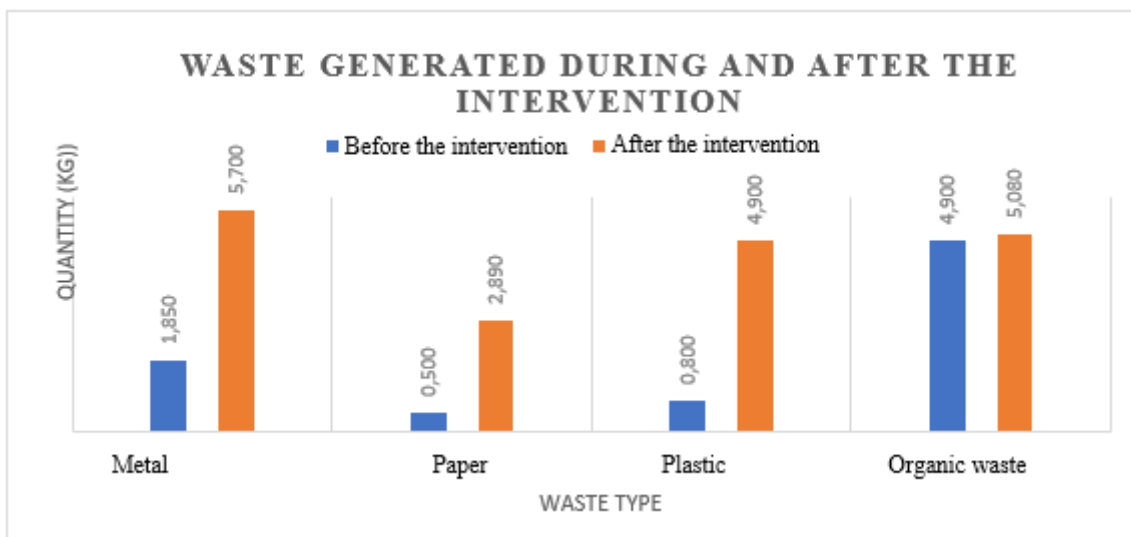


Figure 2. Description of the types of waste generated during and after the intervention.

Source: Own authorship (2019).

The main sources of waste observed in this study allude to the main materials generated within the environment, considered as solid waste, two of them (metal and paper), the most treatable materials and currently the most recycled in the world, highlighting as still a problem. , the plastic waste.

Water pollution is one of the impacts with the most drastic consequences, having immediate damage due to its polluting capacity, can also cause major ecological disasters, with the destruction of large areas in a short time, depending on the material disposed [14]. . The authors also mention that not only in this condition there is degradation, since they act as a wastewater deposit, the result of human neglect.

Thus, in order to report the accounted data and compare the before and after the implementation of the selective collection dumps, we sought to understand the efficiency of the intervention within environmental

education, described through a statistical analysis demonstrating the results achieved (Table 1).

Table 1 - Data collected before and after for each type of waste.

Statistical Measures	Before the intervention	After the intervention
Sum	8,050	18,570
Average	2,013	4,643
Variance (s2)	4,041	1,482
Standard Deviation (s)	2,010	1,218
Amplitude	4,400	2,810
Inferior limit	0,500	2,890
Upper limit	4,900	5,700
Coefficient of variation (CV%)	24,971	6,557
CI (95%)	1,970	1,193

Source: Own authorship (2019).

The total value of the discarded waste difference increased by more than 100%, showing less data variation after the intervention, which characterizes rapid response, but it is not possible to describe if this condition is constant, since education needs time to be effective.

According to [15], the attention that should be given to environmental resources, given the emergency, linked to its use, established an ethical order to reduce this resource, starting an ecological wave, with political responses and daily behavior, including the construction of ecological politics by the way of thinking (perceptions) and the way of acting (actions) and that must present cognitive and affective form. The continuity of the aspects, demonstrated by a formative activity, needs new knowledge, which needs to be systematized, in order to obtain better results [16]. The authors also mention that environmental education promotes procedural and punctual interventions, with a strong individual component, when observing behavior, but with collective orientations aimed at legal action and global thinking.

Environmental education is a continuous process whereby knowledge and information related to environmental issues becomes an important factor to understand how it can become a beneficial agent for the environment [17] and can directly interfere with degradation and preservation of the environment. understanding the types of waste generated and how to carry out their implementation process (Figure 3).



Figure 3. Illustrative mosaic showing the activities.

Source: Own authorship (2019).

The management of environmental activities is necessary to establish a coordinated relationship between the different activities that cause environmental impacts, especially when talking about water resources in large basins.

According to [18], there is no way to talk about water, not to mention health, sanitation, and natural resources in general. Thus, the relationship between environmental education and the insertion of social issues should be described, enabling conditions to initiate the transformative process, with the expressive participation of society [19], centralizing its implementation, and environmental education and the consolidated management model. “Continuously, differently and permanently”, not just performing specific actions, such as booklets, lectures and campaigns, but using the political context based on mobilization and training.

4. Conclusion

The development of the study showed the importance of the environmental approach to encourage the awareness of passengers and crew in the proper disposal of waste generated during travel in waterways, aiming at reducing the impacts caused to the environment. The lectures given emphasized the theme of environmental awareness and had satisfactory results in minimizing waste.

It was found that during the research there was no supervision at the waterway port by the responsible body, which aggravates the situation constantly, given the lack of technicians in the area and legislation relevant to this modal type.

Finally, the research results showed the importance of the disposal of solid waste generated in vessels, and the awareness and awareness of users through environmental education, which, however simple, any intervention becomes important, so that individual actions, become major activities and can add environmental multipliers.

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