

Sensitization for Solid Waste Disposal: Cosmetic Packaging Collection Initiative at a Public University

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This study endeavors to promote the responsible disposal of solid waste within a student environment, addressing concerns regarding the sustainability of our planet. The level of sensitivity and awareness among the academic community regarding proper waste disposal practices was assessed. As an intervention strategy, a collection point was established at a center within UFRB. While most respondents exhibited knowledge of the subject, over 80% highlighted the lack of access to collection points. Furthermore, 84% of respondents believe that initiatives like this one foster proper waste disposal habits, yet only 37% reported utilizing the installed collection point. Consequently, the campaign raises awareness within the community, but more effective measures are necessary to ensure widespread participation.

Keywords: Solid Waste. Proper Disposal. National Solid Waste Policy. Reverse Logistics. Public University.

Understanding the repercussions of climate change on Earth's ecosystems has emerged as a paramount concern. In response, the United Nations established the Intergovernmental Panel on Climate Change (IPCC) in 1988 to advocate awareness and research. Compelling evidence indicates that human activities have contributed to global warming, profoundly impacting the cryosphere, biosphere, oceans, and atmosphere [1].

Examining various emission scenarios outlined in the AR6 climate change report reveals a consistent projection: surface temperatures will continue to escalate until mid-century. Drastic reductions in greenhouse gas emissions are imperative to curtail global warming within the range of 1.5° to 2°C of pre-industrial levels [2]. Implementing changes across multiple domains is essential to mitigate CO₂ emissions and address greenhouse gases, aligning with the UN's Sustainable Development Goals (SDG 13).

Forecasts from the Organization for Economic Cooperation and Development (OECD) anticipate a significant rise in the consumer class with

disposable income, from 1.8 billion in 2010 to nearly 5 billion by 2030. Concurrently, the World Economic Forum predicts a global population of approximately 9 billion by 2030, adding 3 billion new middle-class consumers [3].

In Brazil, discussions surrounding this topic have gained momentum since 2010 with the enactment of the PNRS (National Policy on Solid Waste) Law No. 12,305. This legislation reinforces the prohibition of improper solid waste disposal. Consequently, reverse logistics emerges as a potential competitive advantage for organizations, fostering intellectual growth centered on sustainability [4]. Despite PNRS regulations, approximately 1,657 municipalities in Brazil still rely on landfills, contravening legal mandates [5].

As highlighted by Fernandes and colleagues [6], reverse logistics continually evolves and encompasses returning products to manufacturers, extending material lifespan, and promoting recycling. Post-consumer reverse logistics should be prioritized by organizations, forming a strategic plan to enhance their reputation, reduce costs, bolster market acceptance, and reaffirm environmental commitment [7].

It is crucial to raise awareness among residents regarding their role in managing solid waste, as emphasized by Lima and colleagues [7]. Individuals are primary waste producers, underscoring their responsibility for waste disposal [8].

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This study aims to provide a comprehensive theoretical overview of proper solid waste disposal topics. Additionally, it seeks to assess community engagement within a university setting concerning adopting collection points conducive to appropriate disposal, with the potential for subsequent material selection and recycling initiatives.

Reverse Logistics

Logistics entails the strategic planning, execution, and oversight of the efficient and cost-effective flow and storage of raw materials, in-process inventory, finished products, and associated information from the point of origin to the point of consumption, all aimed at meeting customer demands. However, within this framework lies reverse logistics, which manages the flow from the point of consumption back to the point of origin [4].

Reverse logistics encompasses various facets, including reduction, resource conservation, recycling, replacement, and disposal, mirroring traditional procurement logistics activities such as sourcing, transportation, storage, and packaging [4]. This process involves retrieving products or materials from consumers or end-users, aiming to reintroduce them into the production cycle or ensure proper disposal [6].

National Solid Waste Policy

The National Solid Waste Plan (PNRS) underscores the escalating challenge of waste generation, exacerbated by urbanization, population growth, and consumerist trends. This surge in waste production has emerged as a significant concern for governmental authorities and the global community, given the inherent difficulties in managing and disposing of such vast quantities of waste compounded by their complex chemical compositions. Improper disposal poses grave environmental and human health threats [9].

The PNRS advocates for proactive measures aimed at curbing waste generation and fostering shared responsibility among all stakeholders

involved in waste generation, including manufacturers, importers, distributors, retailers, and consumers. Consequently, a growing impetus exists to expand individual and collective accountability in waste management practices. It is no longer sufficient for manufacturers to address waste generated within their production processes merely; they are now obligated to oversee the product's lifecycle until its eventual disposal [4].

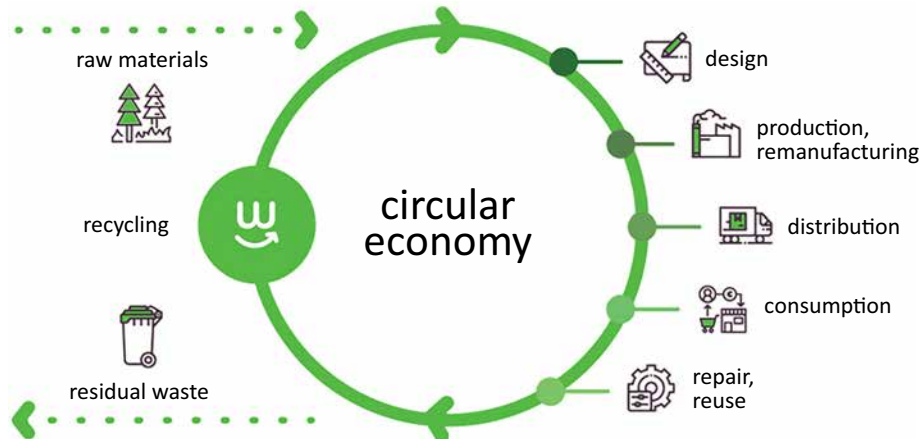
Circular Economy

The notion of a circular economy emerged as a response to the detrimental impacts of linear manufacturing methods, as elucidated in "The Limits of Growth," a seminal publication by the Club of Rome in 1972. This pioneering work highlighted the adverse consequences of resource extraction on terrestrial ecosystems and climate patterns. Linear manufacturing, characterized by material extraction, production, and consumption followed by disposal, perpetuates resource depletion and environmental degradation [10].

In contrast, the circular economy represents a paradigm shift towards sustainability, wherein waste is eliminated, and resources are conserved through continuous reuse, recycling, and regeneration. This approach fosters a symbiotic relationship between economic activities and the biosphere, ensuring minimal ecological footprint. The circular economy embodies a holistic vision of economic development that prioritizes environmental stewardship and resource efficiency (Figure 1).

In the circular economy, processes, services, and products are engineered to prioritize repairability, durability, and upgradability. This contrasts with the linear economy model [11], where products are typically designed with a short lifespan and limited potential for reuse or recycling. The fundamental distinction lies in the circular economy's emphasis on creating a closed-loop system, where materials and resources are continually cycled back into production processes.

From the design phase onwards, there is a concerted effort to ensure that products and services

Figure 1. Circular Economy.

retain their value at the end of their lifecycle [12], serving as productive resources for other industries through remanufacturing and recycling. However, it is essential to maintain the quality of materials throughout the recycling process to ensure their suitability for reuse.

Transitioning to a circular economy requires collaboration across economic sectors involving companies, consumers, and policymakers [13]. This collaborative approach is crucial for achieving resource efficiency and waste reduction outcomes.

Projects designed with a "cradle to cradle" perspective exemplify this approach, aiming to create industrial products and systems that sustain their quality and productivity across multiple life cycles. This philosophy emphasizes the importance of considering the entire lifecycle of products, from raw material extraction to end-of-life disposal, in the design process.

Ultimately, embracing the circular economy requires a shift in both consumer and producer behaviors and changes in education and values. This transformation involves rethinking traditional consumption patterns and adopting more sustainable practices to promote long-term environmental and economic sustainability.

Materials and Methods

The study employed a survey methodology incorporating both quantitative and qualitative

approaches. It was conducted at the Federal University of Recôncavo da Bahia (UFRB), specifically at the Center for Technology in Energy and Sustainability (CETENS), to assess the academic community's engagement regarding proper solid waste disposal.

An online form was created using the Google Forms tool to gauge the community's behavior and understanding regarding solid waste disposal. This form was distributed to the academic community through WhatsApp groups at the center, comprising approximately 250 individuals. Additionally, a QR code was provided on the collection box placed within the center, allowing all nearby individuals to access the form. The form included questions addressing various aspects of solid waste disposal, including understanding, habits, and disposal practices related to post-consumer materials. A total of 64 responses were obtained through the survey, which did not include any demographic or qualification data.

The project extended beyond merely quantifying waste disposal and aimed to encourage future sustainable practices among the community members. A collection box was placed in a high-traffic area within the university campus to facilitate waste collection. The box was constructed using recycled cardboard and metro paper, aligning with the project's sustainability objectives. A booklet containing disposal instructions and information about the ongoing research was placed on the box's surface.

The collection box remained accessible on the university campus for ten days, allowing ample time for community members to dispose of their waste. The sequence of activities carried out throughout the study is depicted in Figure 2, providing a visual representation of the procedures undertaken for better understanding and visualization.

Results and Discussion

The following section will present the survey results for reverse logistics and proper disposal of solid waste collected through a form made available to the academic community of CETENS (Center for Energy and Sustainability) of UFRB, Federal University of Recôncavo da Bahia. In order to carry out the necessary analyses based on data collected from faculty and students on campus, we collected a total of 64 responses.

Analyzing the survey responses provides valuable insights into the community's awareness and engagement regarding the proper disposal of solid waste.

Firstly, the data indicates that a significant portion of the research collaborators (71.9%) are

familiar with the term "conscious disposition," with 17.2% having heard of it a few times and 10.9% having never encountered it before (Question 1). This suggests a baseline level of awareness among the community members. However, approximately 18 individuals are unfamiliar with the concept, which may warrant further attention, especially considering the center's focus on Energy and Sustainability.

Secondly, regarding the community's awareness and engagement with proper waste disposal, a majority (84.4%) indicated some level of concern, with 57.8% sometimes worrying and 26.6% constantly worrying about the issue. However, a notable percentage (15.6%) of respondents rarely or never express concern, highlighting a need to address barriers to engagement (Question 2).

When examining the main limiting factors for community engagement, lack of access to appropriate disposal destinations emerged as the primary concern, cited by 81.3% of respondents (Question 3). This underscores the importance of initiatives such as the project in providing accessible disposal options. However, it is noteworthy that despite the initiative, no packaging was available

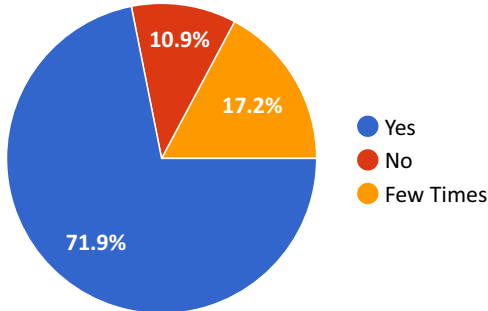
Figure 2. Study framework.



Figure 3. Results of the questionnaire.

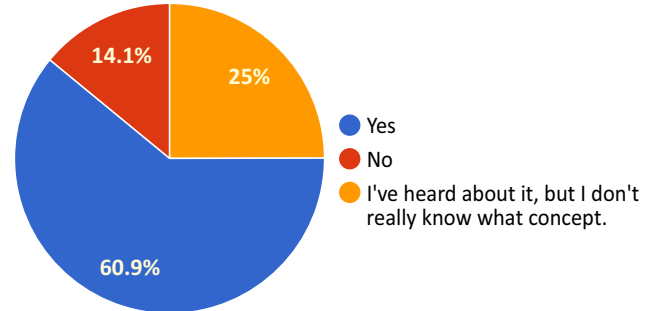
Question 1

Have you ever heard about conscious disposition?



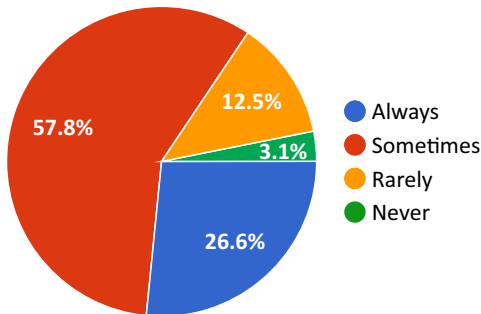
Question 4

Do you know what means reverse logistic?



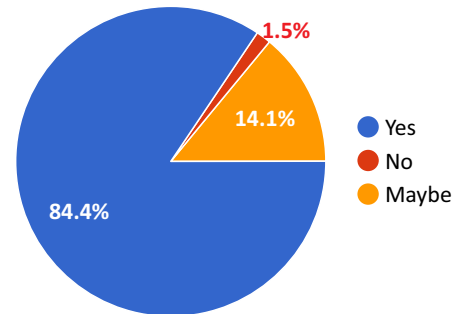
Question 2

Do you usually worry about the proper disposal of waste produced/consumed?



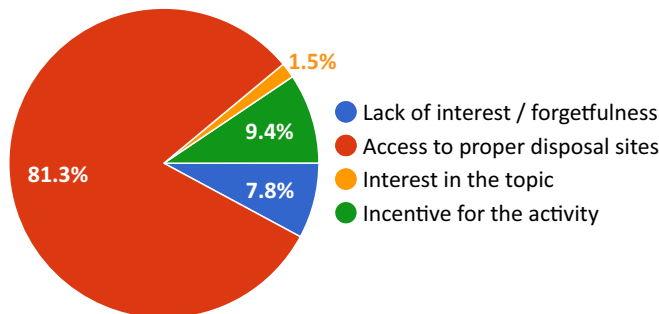
Question 5

Do you believe that the project will encourage you to property dispose of packaging through easy access to the destination location?



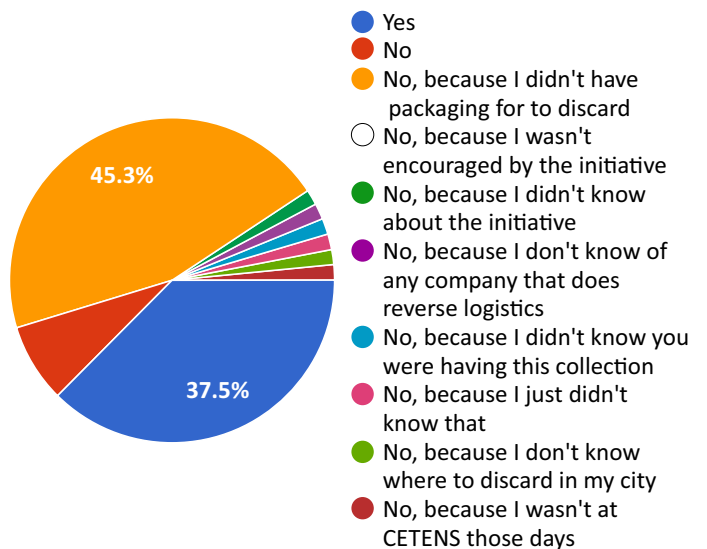
Question 3

What are the main factors responsible for making proper disposal difficult?



Question 6

Are you able to make any disposition of material?



at the designated disposal point, suggesting a discrepancy between community needs and project implementation.

Additionally, while factors such as lack of information (7.8%) and lack of incentive (9.4%) were less frequently cited, they still represent barriers to community engagement. Only a tiny percentage (1.5%) reported a lack of interest in the topic, indicating that awareness and publicity efforts may play a crucial role in fostering community participation (Question 3).

In summary, the survey results emphasize the importance of addressing barriers to engagement and ensuring alignment between community needs and project initiatives to effectively promote proper waste disposal practices. Continued awareness-raising efforts and improvements in project implementation can contribute to increased community involvement and adherence to sustainable waste management practices.

The survey responses shed light on the academic community's awareness of reverse logistics and their perceptions of the project's effectiveness in promoting proper waste disposal.

Firstly, most respondents (60.9%) indicated familiarity with reverse logistics, demonstrating a level of understanding of companies' responsibilities regarding material production and disposal. However, it is notable that a significant portion (25%) have heard of the term but do not fully understand the concept, suggesting a need for further education and awareness-raising efforts (Question 4).

Regarding the project's potential to encourage proper waste disposal, an overwhelming majority (84.4%) expressed confidence that it would incentivize them to dispose of packaging appropriately (Question 5). This positive response indicates strong support for the initiative and suggests that easy access to disposal locations is critical in promoting community engagement.

However, the responses revealed some discrepancies when asked about their disposal behavior. While a substantial number (37.5%) reported having disposed of materials, primarily

due to the lack of packaging, this contradicted the observation that no packaging was provided at the designated disposal location on the CETENS Campus. This inconsistency suggests respondents' potential misunderstanding or misinterpretation of the question, highlighting the importance of clear communication and instructions in future surveys or initiatives (Question 6).

Additionally, some respondents cited forgetfulness (7.8%) as a reason for non-disposal, while a small percentage (1.5%) expressed disinterest or lack of awareness of the initiative (Question 3). These responses underscore the need for ongoing engagement and reminders to encourage consistent participation in waste disposal initiatives.

Overall, while the survey results indicate positive attitudes towards the project and a willingness to engage in proper waste disposal practices, there are opportunities for improvement in communication, education, and implementation to ensure the project's effectiveness and maximize community involvement.

Conclusion

The conclusions drawn from the study highlight the importance of initiatives aimed at proper waste disposal and sustainability within academic communities. While the data indicates a strong interest and willingness to engage in such initiatives, there is a need for increased awareness and ongoing efforts to promote sustainable practices.

One key recommendation is to enhance education and awareness-raising efforts on waste management and sustainability topics. This could involve incorporating these topics into academic curricula, organizing workshops, seminars, and awareness campaigns, and providing regular updates and reminders to the community about the importance of proper waste disposal.

Moreover, the study suggests the development of projects and activities specifically targeted at promoting sustainability within the academic community. These projects could include

implementing additional waste collection points, collaborating with public bodies and organizations to facilitate recycling and waste management, and the organization of debates and discussions on environmental issues.

Notably, the support of the university administration and stakeholders is crucial for the success of these initiatives. By providing resources, funding, and institutional support, the university can drive positive change and foster a culture of sustainability on campus.

Overall, the study underscores the potential for universities to lead by example and serve as catalysts for environmental stewardship and sustainable practices. Through collective efforts and collaboration, academic communities can contribute to addressing environmental challenges and promoting a more sustainable future for all.

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