Journal of Sustainable Community Service
Volume 4 (4), 2024: 233 - 243
E-ISSN: 2986-3384

THE IMPROVED DESIGN OF INORGANIC WASTE BINS TO INCREASE COMMUNITY PARTICIPATION IN MANAGING HOUSEHOLD WASTE

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Abstract

The increase in population significantly impacts the growth of waste volume. In Indonesia, poor waste management exacerbates the issue of waste. In Yogyakarta, specifically, this problem has become critical due to the permanent closure of the integrated waste disposal site that has been relied upon. Despite various government programs being implemented, the active participation of the community as waste producers in addressing waste issues must be continuously enhanced. Independent waste management is one of the frequently proposed solutions. This program is supported by an overarching program called the waste bank. The existence of the waste bank must be accompanied by a high level of community participation. However, the lack of community access to the waste bank needs attention. Accordingly, this community service program will provide inorganic waste bins to increase community participation in managing inorganic waste while supporting the role of the waste bank. There are two main activities in this program: the design and production of inorganic waste bins, and the community education of household waste management. This community service collaborates with the waste bank located in Muja-Muju, Yogyakarta, targeting the campus area of the Faculty of Engineering at UST and the community on Miliran Street. This initiative also involves cooperation between the campus and the bank in institutional-scale waste management.

Keywords: *Waste Management, Waste Bank, Household Waste, Inorganic Waste*

INTRODUCTION

The waste problem in Indonesia is currently one of the most critical issues. The increasing population, coupled with massive regional developments as well as poor waste management, has led to a worsening volume of waste. This issue is prevalent in many major cities in Indonesia. Bogor City, for instance, has experienced a significant increase in waste volume (Ramdhan & Hermawan, 2022). The limited land and suitable locations for waste disposal sites have also caused other areas to share the burden of waste. The local government still relies on the Galuga landfill located in the county area. Additionally, the increase in waste

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volume has also occurred in Serang City and Mataram City (Azmiyati et al., 2022; Mulyati et al., 2023). The high volume of unmanaged waste will eventually become a burden and could potentially impact the landfill capacity owned by each region (Sirait et al., 2021). A similar situation occurred in Yogyakarta, where the provincial government of Yogyakarta permanently closed the Piyungan landfill in April 2024 due to reaching its full capacity (Daeng, 2024). The permanent closure of the Piyungan landfill undoubtedly brings new waste management challenges that cannot be quickly resolved.

Specifically in Yogyakarta, the local government has implemented various waste management programs from upstream to downstream. Downstream waste handling is conducted by the local government through decentralized waste management. This decentralization includes optimizing waste disposal sites within the cities and regencies (Adminwarta, 2023). In the upstream, at the source of waste, the local government collaborates with the community to implement programs such as the zero inorganic waste movement and the bio pore waste processing movement. These initiatives represent waste management at the household level, categorized into organic and inorganic waste. Additionally, the academic sector is involved through community service programs, such as those conducted by (Putra Rananda et al., 2023), which provided training on making stacked gallon compost for kitchen waste, and (Maslamah et al., 2020), which engaged elementary school students in transforming plastic waste into value-added products. The participation of various community elements is expected to be enhanced to create a significant social change.

Household waste management, which constitutes the largest percentage of waste, needs to be driven by additional support programs. In Yogyakarta City, the local government has been supporting a waste bank program, which serves as an umbrella for inorganic waste management initiatives. Currently, there are over 600 active waste banks recorded in Yogyakarta City (Adminwarta, 2023). The presence of these waste banks is expected to enhance community participation in reducing waste volume, particularly inorganic waste. In addition to creating a clean and healthy environment, waste banks can also improve the community's economy by utilizing waste as a source of income (Khaira et al., 2020; Kusuma Wardany et al., 2020). According to (Pratama & Ihsan, 2017), waste banks provide benefits across various sectors, including environmental, social, educational, empowerment, and community-based economy. Despite several benefits provided by waste banks, especially upstream, there are still several challenges related to service management, finance, and organization (Putra et al., 2023; Setiawan & Kurnianingsih, 2021). Limited operational hours,

distance, and human resources are factors that contribute to residents' reluctance to utilize waste bank services. Additionally, the traditional management of organizational and financial aspects tends to keep the scale of waste banks stagnant. One solution to increase community interest in utilizing waste bank services is to establish collection points for inorganic waste. The presence of inorganic waste collection points (inorganic waste bins) closer to residential areas will facilitate the routine disposal of inorganic waste, such as paper and plastic. This approach also eliminates the need for residents to stockpile inorganic waste at home. Based on this background, this community service initiative contributes by providing inorganic waste bins as additional collection points to support waste bank services.

This community service encompasses two main areas: the design and construction of inorganic waste bins, and the community education on organic and inorganic waste management in collaboration with a waste bank located in Muja Muju, Yogyakarta. Additionally, this activity has resulted in a partnership agreement between the waste bank and the Faculty of Engineering at Universitas Sarjanawiyata Tamansiswa (UST), particularly in the management of inorganic waste. A student group from the nature lovers' organization MAPATEK has also been involved to contribute to environmental preservation, focusing on the campus of the Faculty of Engineering at UST and the surrounding area along Miliran street, Yogyakarta.

LITERATURE REVIEW

A. Household Waste Management

The system for managing household waste has been formulated by several academics. (Widiarti, 2012) developed a zero-waste-based household waste management scheme. Household waste is categorized into three main groups: organic waste, inorganic waste, and hazardous and toxic waste. Organic waste includes food scraps, vegetable and fruit peelings, and yard waste. Inorganic waste includes paper, cardboard, plastic, bottles, metal, glass, and fabric, while hazardous and toxic waste includes electronic devices. Waste management begins with waste separation, composting of organic waste, and managing inorganic waste. If household organic waste can be managed independently (on-site) through composting, inorganic waste must be managed with the help of third parties (off-site). Specifically, the management of inorganic waste is divided into three types: paper, plastic, glass, and metal waste that can be given/sold/disposed of to third parties (scavengers, collectors, and waste banks); layered plastic waste that can be sold to recycled product craftsmen; and residual waste. For inorganic residual waste and toxic waste, it is recommended to dispose of them

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E-ISSN: 2986-3384

at transfer stations or final disposal sites with the note that the waste should only be stored for a maximum of 90 days (based on Government Regulation No. 18 of 1999).

Using a similar scheme, Rya Sunoko et al. (2011) designed a community-based waste management system. Household waste is collected and sorted. Rya Sunoko et al. (2011) divides waste into four categories: organic, plastic, paper, and metal, glass, fabric, and others. Suitable organic waste will be composted to produce household compost, while unsuitable organic waste will be disposed of at the sub-district transfer station. Meanwhile, plastic, paper, and metal, glass, fabric waste will undergo three treatments: suitable for sale will be sold to waste collectors, suitable for recycling will be turned into recycled products, and unsuitable for recycling will be disposed of at the sub-district TPS. The framework developed by (Rya Sunoko et al., 2011) does not include the role of waste banks and does not provide recommendations for the management of hazardous and toxic waste. Additionally, Subekti, (2009) reviews household waste management using the 3R (reuse, reduce, and recycle) method. Reuse refers to the direct reuse of waste, either for the same function or a different one. Reduce means reducing anything that causes waste generation. Recycle involves reusing waste after it has undergone a processing stage. (Subekti, 2009) provides illustrations of the 3R method for households, offices, schools, public facilities, commercial areas, trading centers, and markets.

B. Waste Managament Innovations by University Academics

Various innovations have been designed and developed, primarily by academics, and implemented in community service programs. Organic waste processing innovations have been developed by (Zayadi, 2018) and (Primaturrisma & Dhokhikah, 2020). Zayadi (2018)designed a recycle drum, which is a plastic drum that can produce liquid organic fertilizer. Meanwhile, Primaturrisma & Dhokhikah (2020) implemented a vermicomposting program, which involves making compost with the help of earthworms and livestock manure. Additionally, innovations in inorganic waste processing have been practiced by (Lestari et al., 2019) through a product called Lentera, which is an innovative process of turning plastic waste into multifunctional lamps that have added value and aesthetic appeal. Besides lamps, these recycled inorganic waste products can also be used as pencil holders, tissue holders, and savings containers. (Primaturrisma & Dhokhikah, 2020) has also practiced the processing of inorganic waste into eco bricks.

Waste processing innovations for larger scale potential have been practiced by (Oktora et al., 2019) and (Sucahyo & Fanida, 2021). Oktora et al. (2019) has practiced converting

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E-ISSN: 2986-3384

waste into fuel, using the principle of pyrolysis to turn plastic waste into fuel oil. Meanwhile, Sucahyo & Fanida (2021) reviewed the development of landfill gas collection and gasification technology to manage waste into electricity at the institutional level.

This paper reports community service activities through the development, production, and distribution of inorganic waste collection points within community groups. Despite various waste processing innovations applied at the household level, the role of inorganic waste collection points still provides significant benefits, especially in supporting the existence of waste banks. Inorganic waste collection points can reduce the burden on households to collect waste, which may require storage space. As a result, the social behavior of the community to collect and immediately dispose of inorganic waste at the collection points is increasing. Consequently, the role of waste banks, as entities in the household waste management scheme according to (Widiarti, 2012), will also increase.

METHOD

The scope of this community service activity includes two main components: 1) the design and creation of waste bins specifically for plastic waste, and 2) the community education in collaboration with a waste bank. In the second activity, a cooperation agreement was initiated between a waste bank located in the Muja Muju area of Yogyakarta City and the Faculty of Engineering UST as the implementing team. The target audience for this activity includes the residents of Miliran street in Yogyakarta City, the cleaning service officers, and the nature-loving students from the Faculty of Engineering UST. The activities within this community service program are:

a. The design of inorganic waste bins

The design of inorganic waste bins involved comparative studies at several locations. Additionally, the design phase took into consideration the types of inorganic waste that could be handled by the nearest waste bank. Based on these comparative studies and discussions with waste bank managers, the design of the inorganic waste bins was developed to accommodate inorganic waste collection points. Moreover, the inorganic waste bins were also designed as educational media, featuring stickers/posters to encourage greater community participation in inorganic waste collection.

b. Production of inorganic waste bins

The next stage is the production of the waste bins. The primary materials used are light iron and wire mesh. Additionally, the size of the waste bins is also considered so that the bins can attract the attention of passing residents, even from a considerable distance. The

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production of the inorganic waste bins is carried out in collaboration with the Vocational Mechanical Engineering Education Laboratory Unit at UST.

c. Community education

The next activity is the handover of the waste bins to the local community groups, along with education on household waste utilization. In this activity, the service team collaborates with waste bank managers to provide education on household waste management.

d. Signing of the agreement with the waste bank

The final activity of this community service program is the signing of an agreement between the Faculty of Engineering UST and a waste bank located in the Muja-Muju subdistrict of Yogyakarta City. This activity is expected to serve as a catalyst for cleanliness programs, especially within the campus area, managed by the cleaning service officers and student groups associated with the nature lovers' club.

RESULTS AND DISCUSSION

A. Design and production of inorganic waste bins

The initial activity of this community service project involves designing and producing inorganic waste bins intended for the campus environment and the surrounding residential areas. The design of these inorganic waste bins aims to accommodate various types of inorganic waste, as referred to in (Widiarti, 2012), where inorganic waste processed by waste banks includes paper, plastic, glass, and metal. Furthermore, comparative studies to several locations that have already implemented inorganic waste bins were conducted to gather additional design references. Figure 1 presents two examples of inorganic waste bins that have been implemented in the Baturetno Banguntapan Bantul area, Yogyakarta.

From the two displayed designs, Design A is an inorganic waste bin created to accommodate plastic waste only, specifically plastic beverage bottles. Meanwhile, Design B is designed to hold two types of inorganic waste: paper (including cardboard) and plastic bottles. A bottle cap compartment is added to Design B due to a request from the waste bank partner to separate plastic bottles from their caps, facilitating the sorting process at the waste bank. Considering these two reference designs, this community service project produces two types of inorganic waste bins: Design A, which will be placed on campus, and Design B, which will be placed in the residential areas around the campus. Design A is placed on campus because paper waste is already managed by the cleaning staff in cooperation with waste collectors, whereas plastic waste is not yet well managed, making Design A the appropriate choice.

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Design B is placed in the residential areas around the campus to accommodate a more varied range of inorganic waste. Additionally, both waste bin designs will feature stickers that provide education and encourage household waste management.

Design A Design B

Figure 1. The different design of inorganic waste bins

Figure 2. The improved design of inorganic waste bins

Based on the two reference designs (Design A and Design B), we have developed an improved design of inorganic waste bins (Figure 2) that is more efficient and aesthetically pleasing. The bin is primarily designed to accommodate two types of inorganic waste: paper and plastic bottles. Additionally, the waste bin is designed with user-friendly usability for both contributors and future waste managers. However, this design has limitations, as it is not yet capable of accommodating other types of inorganic waste such as glass or metal. This

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limitation could be followed up in future studies, considering the significance of direct waste collection contributions by the community.

B. Community education and agreement

The second activity involves education on household waste management, targeting the community around the Faculty of Engineering UST located on Miliran street, campus cleaning staff, and students participating in the MAPATEK organization. The outreach and education activities are conducted in the basement of the Faculty of Engineering at UST. There are two main agenda in this educational activity: household waste management and community-level government programs, as well as the application of LOSIDA (kitchen waste collection pipe) for organic waste management as presented in Figure 3. The LOSIDA topic is part of a community service collaboration funded by Universitas Atma Jaya Yogyakarta (Puspitasari & Anindyajati, 2023).

Figure 3. The photos of community education and signing of agreement

The speaker for this activity is the manager of the Muja-Muju waste bank, who is also a facilitator for the waste banks in Yogyakarta City. The series of activities is conducted in a structured manner, starting with explanations about organic, inorganic, and hazardous waste, recording household waste management processes, and demonstrating the use of organic waste processing tools, specifically LOSIDA. Additionally, the inorganic waste bins resulting from this community service activity will serve as collection points for inorganic waste, providing a more accessible location for residents around Miliran street. The designed inorganic waste bins can hold bottles and plastics, and designated community representatives are assigned to deliver this collected waste to the waste bank during its operational hours. To formalize this initiative, the Faculty of Engineering at UST collaborates with the waste bank, marked by a memorandum of agreement during this activity.

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CONCLUSION

This community service activity has been successfully conducted as an emergency response to the waste crisis announced by the local government of Yogyakarta City. The output of this activity includes trash bins capable of holding inorganic waste, which will be placed in two locations: around Miliran street and the Faculty of Engineering campus at UST. Additionally, outreach activities and the signing of a cooperation agreement were conducted to increase community awareness and understanding of household waste management. The produced inorganic waste bins also serve as more accessible collection points for inorganic waste for the community. Formal cooperation has been initiated, marked by the signing of a memorandum of agreement (MoA) between the Faculty of Engineering at UST and the waste bank.

The limitation of this community service activity is that the design of the improved inorganic waste bins accommodates only two types of inorganic waste, namely paper and plastic bottles. These two types of waste were selected based on the frequency and quantity that are likely prevalent in the community. However, further study is needed to develop inorganic waste bins or waste collection points for other types of inorganic waste.

ACKNOWLEDGMENT

The authors would like to thank the Institute of Research and Community Services (Lembaga Penelitian dan Pengabdian kepada Masyarakat/LP2M) at Universitas Sarjanawiyata Tamansiswa for providing financial support for the implementation of this community service activity, including the writing and publication of the article, through the 2024 Community Partnership Service (Abdimas Kemitraan Masyarakat) scheme (Grant No: 035/UST/LP2M/K/ABDIMAS/AKM/IV/2024).

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