Empowering the community through plastic waste management and eco-friendly construction materials in Bangunjiwo Village

Ahmad Zaki[1*], *Seplika* Yadi[2], *Khairil* Mahbubi[1], *Kharisma* Wira Nindhita[1], *Amir* Fauzi[3]

[1]Magister of Civil Engineering, Postgraduate Program, Bantul 55183, Universitas Muhammadiyah Yogyakarta, Indonesia
[2]Department of Civil Engineering, Faculty of Engineering, Bantul 55183, Universitas Muhammadiyah Yogyakarta, Indonesia
[3]Department of Civil Engineering, Faculty of Engineering, Lhokseumawe 24301, Politechnic Negeri Lhokseumawe, Indonesia

Abstract. This study addresses the critical issue of plastic waste management in Bangunjiwo Village, Yogyakarta. With Indonesia generating 22.92 million tons of waste in 2023, and plastic waste constituting 19% of this total, effective management solutions are essential. The program involved socialization through Focus Group Discussions (FGD) and evaluation using questionnaires. The FGD sessions educated 23 community leaders on waste management technologies and the potential use of plastic waste in eco-friendly construction materials. Evaluation results showed that over 57% of participants had a strong understanding and awareness of the negative impacts of plastic waste and the importance of the 3Rs (Reduce, Reuse, Recycle). Additionally, more than 52% strongly agreed on the importance of recycling and innovative plastic waste processing. The high willingness to participate in waste reduction and management initiatives highlights significant potential for implementing plastic waste recycling programs in the village. Continuous education and the provision of appropriate processing technologies can transform plastic waste into valuable, sustainable construction materials, supporting both environmental conservation and local infrastructure development. This study underscores the crucial role of community participation and ongoing education in achieving effective plastic waste management.

1 Introduction

Waste management has become one of the crucial issues that must be addressed seriously to tackle environmental problems. Unmanaged waste can contaminate the environment, threaten the sustainability of natural resources, and harm public health [1]. Therefore, concrete actions in waste management are essential, including through community service programs. According to the National Waste Management Information System, Indonesia

* Corresponding author: ahmad.zaki@umy.ac.id

generated 22.92 million tons of waste in 2023, as shown in Figure 1. The most significant proportion of waste is food waste at 41.55%, followed by plastic waste at 19% [2].

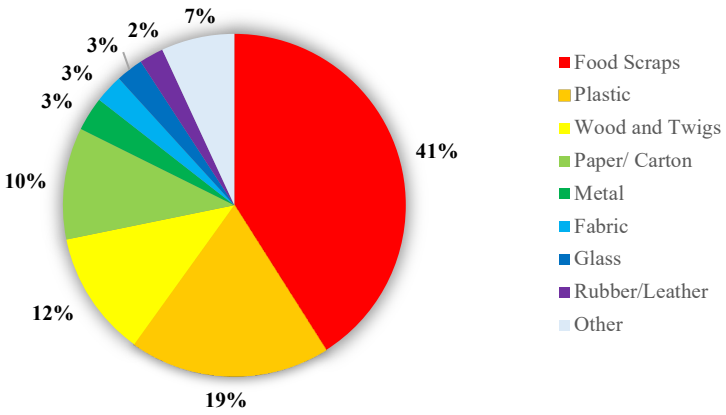

Fig. 1. Data on waste generation in Indonesia 2023.

The Special Region of Yogyakarta (DIY) is one of the areas facing significant waste management challenges. Although the Yogyakarta city government has mandated the separation of organic and inorganic waste due to the nearly complete condition of the Piyungan landfill, improper waste disposal practices remain common among residents [3]. According to the Yogyakarta Regional Government, in 2023, the volume of waste from Yogyakarta City, Bantul, and Sleman exceeded 700 tons per day [4]. The excess volume of waste surpassing the daily capacity of the Piyungan landfill accelerates its depletion. This problem is also evident in Bangunjiwo Village, Kasihan Subdistrict, Bantul. Therefore, steps and solutions to reduce waste on the ground are necessary, one of which is the innovation of using waste as a construction material mixture, such as paving blocks, wall bricks, roofing, and beams.

Inorganic waste is problematic due to its non-biodegradable nature. Producers and consumers consider the use of inorganic packaging a common urban practice. Waste management can be conducted with the 3R principles (Reduce, Reuse, Recycle) [5]. Waste management, both organic and inorganic, implementing recycling principles, has been widely practiced by waste banks and households concerned with waste issues. Many waste utilization efforts have been directed toward producing construction materials, such as bricks, which are crucial materials in the construction industry. Various efforts have been made to incorporate waste into brick production, such as using paper processing residue [6], cigarette butts [7], plastic fibers [8], straw [9], rice husk ash [10], rubber [11], kraft pulp production residue [12] and sawdust [13]. Paving blocks are also widely used construction materials due to their long lifespan, quick and easy production, and ease of replacement for maintenance purposes [14]. The disposal of various wastes can be utilized in paving block production, such as recycled concrete waste [15], rubber waste [16], and plastic waste [17]. Using paving blocks with waste mixtures provides benefits to the community, as recycled materials play a crucial role in today's environment, and the production of specially designed pavers with waste mixtures is believed to enhance production potential [18].

Plastic is used in large quantities due to its advantageous properties, such as being lightweight and easy to mold. Compared to other widely used materials like paper, ceramics, glass, and aluminum, plastic is less recycled. The numerous stages involved in plastic recycling—production, distribution, usage, disposal, and sorting—make the entire process

complex. Using plastic waste for construction applications significantly enhances environmental sustainability and serves as a reliable source of materials for construction purposes [19-21]. This community service project explores the utilization of plastic waste in Bangunjiwo Village as eco-friendly construction materials. By converting plastic waste into valuable construction products, such as eco-friendly paving blocks, this project aims to provide sustainable solutions aligned with environmental conservation goals while improving local infrastructure. The initiative seeks to empower the community through education and training, enabling residents to participate actively in waste management and eco-friendly construction practices.

2 Methodology

This project employs a participatory approach involving Focus Group Discussions (FGD) and evaluations to engage the Bangunjiwo Village community and assess the effectiveness of interventions. This methodology is designed to ensure active community involvement, provide education on waste management, and gather feedback for continuous improvement. A committee will be formed to organize and oversee the selection and collection of waste from each household. Subsequently, efforts will be made to create construction materials from the collected plastic waste, ensuring they are suitable for use in various construction applications.

2.1 Focus group discussion (FGD)

The FGD sessions serve as a platform to socialize and disseminate information about plastic waste management and its potential use in eco-friendly construction materials. Two main topics were presented during these sessions. The first session, led by Dr. Ir. Novi Caroko, S.T., M.Eng., titled “Waste Treatment with Incinerator and Pyrolysis Methods,” focused on educating the community about waste management technologies for all types of waste using incinerator and pyrolysis methods. This session included discussions on the environmental impact of waste, current waste management practices in Yogyakarta, and the benefits of reducing, reusing, and recycling waste. The second session, presented by civil engineering lecturer Dr. Ir. Seplika Yadi, S.T., M.T., introduced the concept of using plastic waste as a material for green construction. This session covered an overview of green construction materials and their benefits and the process of converting plastic waste into construction materials, such as beams made from plastic waste materials. Both sessions aimed to provide a comprehensive understanding of the project's objectives and the potential benefits of their participation in the plastic waste management initiative to the community.

2.2 Evaluation

To evaluate the effectiveness of the FGD sessions and gather feedback from the community, a Likert scale questionnaire was distributed to participants. The questionnaire contained 13 questions covering three main components: participants' understanding and awareness, perceptions of plastic waste management, and willingness to participate. Participants rated each statement on a five-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree." The collected data were then analyzed to determine the overall effectiveness of the FGD sessions and identify areas for improvement.

3 Results and Discussion

3.1 Socialization of Community Service Program

The socialization of the community service program was conducted at the Muhammadiyah Bangunjiwo Barat Branch Building. The FGD was attended by 23 participants from Bangunjiwo community leaders. Figure 2 shows the documentation of the program socialization and FGD activities. At the end of the discussion, the participants determined the activities for waste selection and collection from each household and planned the subsequent activities for creating suitable construction materials from the collected plastic waste.

3.2 Evaluation of the Program

Participants filled out questionnaires regarding their responses to the plastic waste management materials presented during the socialization. In this study, the FGD involved 23 respondents with 13 questions. The results are shown in Figure 2. For questions related to participants' understanding and awareness (questions 1-4), more than 57% strongly agreed that they understood and were aware of the negative impacts of plastic waste accumulation and the importance of practicing the 3Rs. For questions about perceptions of plastic waste management (questions 5-10), the majority strongly agreed (>52%) on the importance of recycling and innovative processing of plastic waste. However, the majority also agreed (>52%) on efforts to process plastic waste into construction materials. For questions regarding community willingness to participate (questions 11-12), there was a high level of willingness to engage in efforts to reduce and manage plastic waste.

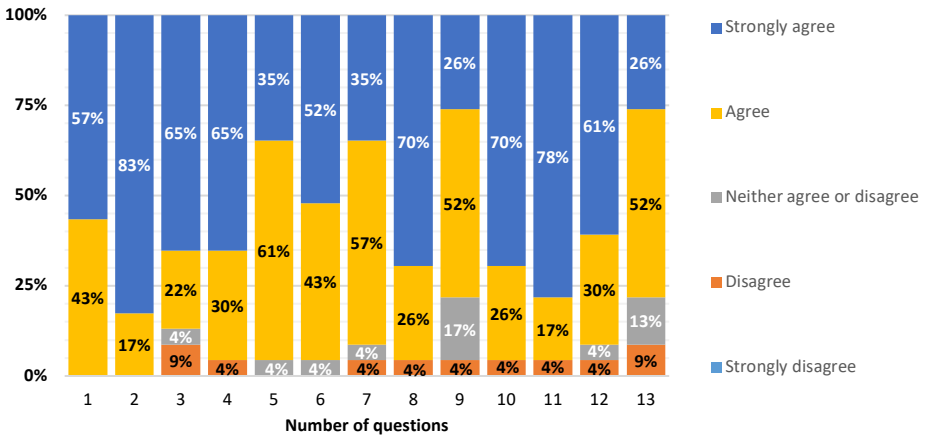

Fig. 2. Results of questionnaire analysis.

The results of this study show that most respondents in Bangunjiwo Village have a high level of understanding and awareness regarding the importance of waste management, especially plastic waste. The findings also indicate that the community is open to modern technology as an effective waste management solution. However, further education on the common types of plastics encountered is needed, as only 57% of respondents had a good understanding of different types of plastic waste. The high willingness to participate in recycling and innovative plastic waste management shows significant potential for implementing programs to process plastic waste into construction materials in Bangunjiwo

Village. Strong community participation is a crucial asset for the success of this community service program.

Overall, the results of this study support the importance of continuous education and socialization regarding plastic waste management and its economic potential. By enhancing community understanding and awareness and providing appropriate processing technologies, plastic waste can be transformed into beneficial and sustainable construction materials.

4 Conclusions

The results of this study indicate that the socialization and evaluation efforts in Bangunjiwo Village have successfully enhanced the community's understanding and awareness of plastic waste management. Most respondents comprehend the importance of practicing the 3Rs (Reduce, Reuse, Recycle) and accept modern technology as an effective solution. However, further education on types of plastics is needed to improve community knowledge. The high willingness of the community to participate in waste reduction and processing efforts shows significant potential for implementing recycling programs and innovative plastic waste processing into construction materials. With ongoing education and appropriate processing technology, plastic waste can be transformed into valuable and sustainable materials, thereby supporting the success of this community service program.

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