

Recycled Plastic Crafts and Eco-Enzyme: Community Practices for Sustainable Waste Management in Serangan Village, Bali

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Abstract

Sustainable waste management is essential for reducing the environmental impacts of increasing plastic and organic waste generation while promoting environmental sustainability. This study aims to examine community-based waste management practices implemented by the Angen Bali Community in Serangan Village, Denpasar, Bali, through plastic recycling crafts and eco-enzyme production as part of the Sustainable International Community Service (SICS) program. A descriptive qualitative approach was employed using field observations, semi-structured interviews, documentation, and a literature review. Data were analyzed using the Miles and Huberman interactive model and supported by methodological triangulation. The findings indicate that the community implements an integrated waste management system through waste segregation, plastic recycling, and organic waste utilization. Plastic bottle caps are transformed into handicraft products with functional, aesthetic, and economic value, while organic waste is processed into eco-enzyme through anaerobic fermentation for household and agricultural use. These practices promote circular economy and 3R principles, strengthen community participation, reduce waste generation, and support sustainable environmental management through environmental education and practical demonstrations.

Keywords: *Circular economy; Community-based waste management; Eco-enzyme; Plastic recycling; Sustainable waste management.*

I. INTRODUCTION

Waste management has become one of the major challenges in achieving sustainable development, particularly in regions experiencing rapid economic growth and intensive community activities. Waste is defined as unwanted residual material generated after the completion of a process. In natural ecosystems, however, the concept of waste does not exist, as all materials produced during natural processes become part of another cycle. In contrast, humans define waste based on its level of usability or perceived value (Dr. Yudiyanto, S.Si. et al., 2019). As a city whose economy is driven by the tourism, trade, and service sectors, Denpasar City generates a substantial volume of municipal solid waste each day, thereby requiring effective and sustainable waste management strategies (Tapa et al., 2026). According to the Denpasar City Environmental and

Sanitation Agency (2025), the TPS3R Serangan waste management facility generates approximately 11,290 kg of waste per day, with around 9,000 kg of waste entering the facility daily. However, only about 1,550 kg of this waste is successfully processed. These figures indicate that community-based waste management capacity remains insufficient and requires further improvement to minimize the amount of unprocessed waste.

One of the main factors contributing to the increasing volume of waste is the perception among some community members that waste has little or no value, resulting in inadequate waste management practices. Consequently, the continuous accumulation of waste may lead to environmental pollution and negatively affect the quality of life of the community (Yulistiar & Manggalou, 2023). This issue has also received significant attention from the Indonesian government through Law No. 18 of 2008 on Waste Management. The policy is further strengthened by Minister of Environment and Forestry Regulation No. P.75 of 2019, which requires producers to reduce packaging waste generation by 30% by 2030, as well as through the implementation of the Extended Producer Responsibility (EPR) policy, which encourages industries to take responsibility for managing the plastic waste generated by their products. One approach that can be implemented to address this issue is the 3R concept (Reduce, Reuse, and Recycle), which emphasizes reducing the use of materials that may become waste, reusing items that are still suitable for use, and recycling waste into valuable products (Tapa & Wiguna, 2025). In general, plastic waste is processed into handicraft products for several reasons, particularly to reduce the accumulation of plastic waste in the community and to create alternative sources of income for local residents (Hulaikah & At-tanwir, 2022). The implementation of the 3R concept is expected to increase public awareness while reducing the amount of waste disposed of in landfills.

In addition to implementing the 3R concept, organic waste can also be managed through the utilization of eco-enzyme as an environmentally friendly alternative. Eco-enzyme is a multifunctional liquid produced through the fermentation of organic waste and can be used for various household and environmental purposes (Masriatini et al., 2024). Its production involves an anaerobic fermentation process in which microorganisms utilize carbohydrates as an energy source, producing eco-enzyme as the primary product and alcohol or acetic acid as by-products (Sebayang et al., 2024). On the other hand, plastic waste also requires proper management because burning plastic can release hazardous air pollutants, including carbon dioxide (CO₂), carbon monoxide (CO), nitrogen oxides (NO), and sulfur oxides (SO), which pose risks to human health (Laily Khairiyati, S.K.M. et al., 2021). Besides reducing the negative impacts of household organic waste, the application of eco-enzyme can also improve community knowledge and provide practical benefits in everyday life (Artaya et al., 2024).

Based on these conditions, the Sustainable International Community Service (SICS) program was implemented in Serangan Village through training on plastic recycling crafts and eco-enzyme production as a community empowerment initiative for sustainable waste management. The program aimed to improve the knowledge and skills of community members in transforming plastic and organic waste into valuable products. Through active community participation, the program is expected to foster responsible waste management practices and contribute to sustainable environmental development in Serangan Village.

II. METHOD

This study employed a descriptive qualitative approach to examine community-based waste management practices through recycled plastic crafts and eco-enzyme production implemented by the Angen Bali Community in Serangan Village, Bali. A qualitative approach was selected to provide an in-depth understanding of the observed phenomena in their natural setting (Dr. H. Zuchri Abdussamad, S.I.K., 2021). Primary data were collected through observation, semi-structured interviews, and documentation, while secondary data were obtained from relevant literature on waste management, the Reduce, Reuse, and Recycle (3R) concept, recycled plastic crafts, and eco-enzyme utilization (Laily Khairiyati, S.K.M. et al., 2021). Data were analyzed using the interactive model of Miles and Huberman, including data reduction, data display, and conclusion drawing, while data credibility was ensured through triangulation (Dr. H. Zuchri Abdussamad, S.I.K., 2021).

III. RESULT AND DISCUSSION

Waste Management Practices at the Angen Bali Community:

The Sustainable International Community Service (SICS) program was conducted at the Angen Bali Community (KKB Kontainer Serangan) in Serangan Village, South Denpasar District, Denpasar City, Bali. This community represents a community-based initiative that actively supports waste management through an empowerment approach based on the principles of the circular economy. Unlike conventional waste management systems, which primarily focus on waste collection and disposal at final disposal sites, the Angen Bali Community implements waste reduction strategies at the source through educational activities, waste sorting, material reuse, and organic waste processing. Based on field observations, waste management within the community is carried out through several stages, beginning with the separation of organic and inorganic waste. Organic waste, such as fruit peels and vegetable residues, is utilized as raw material for eco-enzyme production, while inorganic waste, particularly plastic packaging, is cleaned, sorted according to its type, and transformed into various handicraft products. This system demonstrates that a large proportion of the collected waste still has the potential to be reused, thereby reducing the amount of waste ultimately disposed of at landfill sites.



Figure 1 show observation activities at the Angen Bali Community.



Figure 2 show interview with Mr. Majes on waste management practices

The interview with the manager of the Angen Bali Community revealed that the success of waste management depends not only on the availability of facilities and infrastructure but also on

the level of public awareness regarding household waste segregation. According to the interviewee, many households still dispose of organic and inorganic waste together, making the waste processing process less efficient. Therefore, continuous educational activities play an important role in fostering responsible waste management practices within the community. These findings are consistent with the concept of sustainable waste management, which emphasizes that the effectiveness of waste management systems depends not only on technical aspects but also on changes in community behavior to reduce waste generation at its source. Therefore, a community-based approach represents an effective strategy for supporting the implementation of the Reduce, Reuse, and Recycle (3R) principles.

Utilization of Plastic Bottle Caps for Handicraft Production:

Based on field observations and information obtained from the resource person at the Angen Bali Community in Serangan Village, South Denpasar District, Denpasar City, one of the inorganic waste management practices implemented by the community is the utilization of plastic bottle caps to produce various handicrafts with functional, aesthetic, and economic value. This activity represents the application of the circular economy concept through the principles of reuse and recycle by maximizing the utilization of waste materials so that they remain valuable instead of becoming waste. In addition to receiving information on the importance of plastic waste management, participants were also introduced to the complete processing stages through direct demonstrations, from waste collection to the production of finished handicraft products. The plastic bottle caps used in this activity were collected from various types of discarded bottle caps. Based on field observations, the processing began with sorting the bottle caps according to their plastic type and color. This stage was intended to obtain uniform raw materials, thereby facilitating the processing stages and ensuring consistent product quality and appearance. After the sorting process, the bottle caps were shredded into small pieces to facilitate further processing.



Figure 3 show sorting and processing of plastic bottle cap waste at the Angen Bali Community.



Figure 4 show examples of handicraft products made from recycled plastic bottle caps.

The shredded plastic was then washed to remove dust, dirt, and other residues attached to the surface. After washing, the material was air-dried thoroughly to eliminate moisture that could affect the quality of the final product. Based on the demonstration provided by the resource person, the dried plastic fragments were subsequently melted using a heating device until the material became soft and moldable. The molten plastic was then poured into molds according to the desired product

design. After molding, the products were allowed to cool and harden before undergoing finishing processes, including trimming, quality inspection, and cleaning, to produce durable, neat, and visually appealing handicrafts.

According to the interview with Mr. Majes, the manager of the Angen Bali Community, the utilization of plastic bottle cap waste serves as an effort to reduce the amount of plastic waste ending up in landfills while simultaneously creating products with practical use and economic value. The interviewee also explained that this activity functions as an educational medium to increase public awareness that plastic waste can still be reused when managed appropriately. This approach is expected to change public perceptions by demonstrating that waste should not merely be regarded as discarded material but can instead become a valuable resource through creative and sustainable processing.

The findings indicate that recycling plastic bottle caps into handicraft products generates creative products with significantly higher value than the original waste materials. These products not only serve decorative and functional purposes but also possess economic value, making them suitable for commercialization as environmentally friendly handicraft products. This innovation demonstrates that plastic waste, which has long been recognized as one of the major contributors to environmental pollution, still has considerable potential to be transformed into valuable products through appropriate processing techniques.

These findings are consistent with the study by Mifta Hulaikah, which states that recycling plastic waste into handicraft products aims not only to reduce the accumulation of plastic waste within communities but also to create economic opportunities as an alternative source of income for local residents. The transformation of waste into value-added products demonstrates that waste management extends beyond environmental protection by also generating social and economic benefits through the development of creative recycling-based products.

In addition to generating economic value, recycling plastic waste into handicraft products represents a more environmentally friendly waste management alternative than open burning. According to Laily (2021), burning plastic waste releases hazardous gases, including carbon dioxide (CO₂), carbon monoxide (CO), nitrogen oxides (NO), and sulfur oxides (SO), which may have adverse effects on both human health and the environment. Therefore, the waste management practices implemented by the Angen Bali Community provide a more sustainable solution by reducing environmental pollution while increasing the value of plastic waste through innovative handicraft production.

Education on Organic Waste Utilization through Eco-Enzyme Production:

In addition to receiving training on plastic waste utilization, participants also attended an educational session on organic waste management through eco-enzyme production. The session was delivered by a resource person from the Angen Bali Community as an example of an environmentally friendly approach to utilizing household organic waste. During the session, participants were introduced to the basic concept of eco-enzyme, its environmental benefits, and its role in reducing the amount of organic waste generated from household activities. This activity aimed to enhance participants' understanding of a simple and practical alternative for managing organic waste that can be easily adopted by the community.



Figure 5 show educational session on eco-enzyme production.



Figure 6 show demonstration of the eco-enzyme production process.

Based on field observations, the resource person demonstrated the process of producing eco-enzyme using readily available materials, including organic waste such as fruit peels and vegetable scraps, brown sugar or molasses, and water. All ingredients were mixed in specific proportions in a sealed container and then fermented for several months to produce eco-enzyme liquid. During the demonstration, the resource person also emphasized the importance of maintaining the correct proportion of ingredients and ensuring the cleanliness of the container to achieve an effective fermentation process and produce high-quality eco-enzyme.

According to the interview with Mr. Majes, the manager of the Angen Bali Community, the utilization of organic waste through eco-enzyme production represents an effort to reduce the amount of organic waste that is commonly discarded without further processing. The interviewee explained that eco-enzyme has various practical applications in daily life, including its use as a natural cleaning agent, liquid fertilizer, and an environmentally friendly solution for reducing pollution caused by the accumulation of organic waste. In addition to its environmental benefits, eco-enzyme production also serves as an educational tool that encourages communities to become more aware of responsible household waste management practices.

Field observations indicated that the educational session and demonstration of eco-enzyme production improved participants' understanding of the importance of utilizing organic waste as a valuable resource. The activity demonstrated that organic waste should not always be regarded as material to be discarded but can instead be transformed through fermentation into useful products for everyday applications. This approach represents a sustainable waste management practice by promoting the utilization of organic waste and reducing waste generation at its source.

These findings are consistent with those reported by (Masriatini et al., 2024), who stated that eco-enzyme is a multifunctional liquid produced through the fermentation of organic waste and can be utilized in various daily activities. The production process takes place under anaerobic fermentation conditions, resulting in eco-enzyme as the primary product, while alcohol and acetic acid are generated as by-products (Sebayang et al., 2024). In addition to reducing the negative impacts of household organic waste, the application of eco-enzyme has been shown to enhance public knowledge of environmentally friendly waste management practices and provide practical benefits in everyday life (Artaya et al., 2024).

Community Participation, Program Impact, and Its Contribution to the Sustainable Development Goals (SDGs):

The implementation of the Sustainable International Community Service (SICS) program at the Angen Bali Community demonstrated active participation from community managers in providing education on plastic and organic waste management. Through observations, demonstrations, discussions, and interviews, participants gained a better understanding of how waste can be transformed into valuable products and recognized the importance of community-based waste management in supporting environmental sustainability. Based on field observations, the program had a positive impact on improving participants' knowledge and awareness of sustainable waste management practices, techniques, and provide environmental as well as economic benefits.

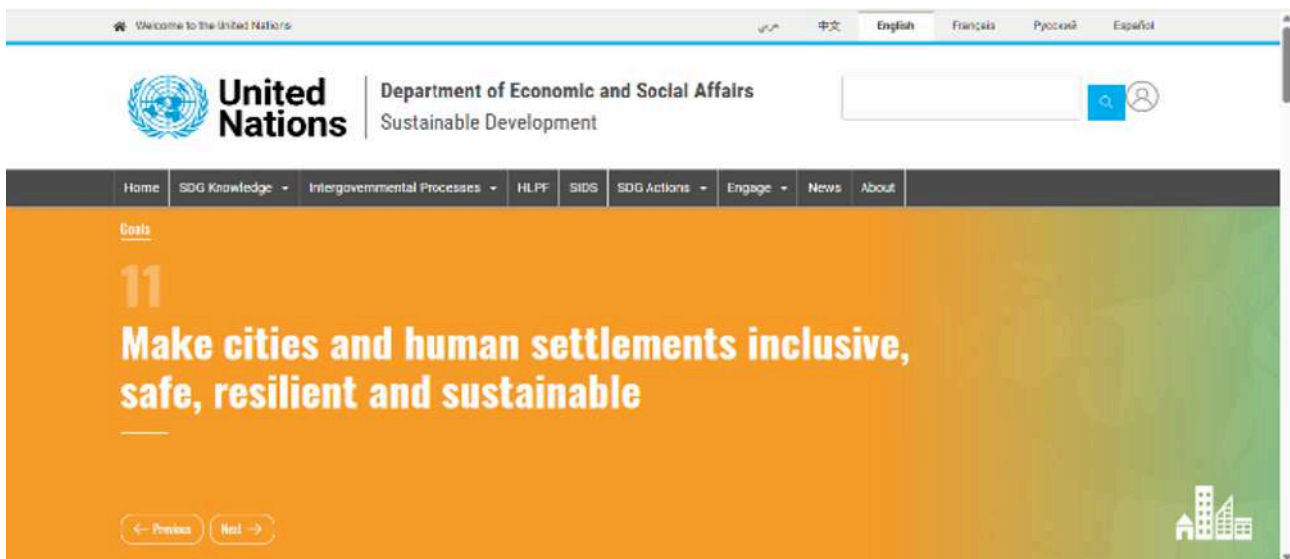


Figure 7 show SDGs 11

This program contributes to the achievement of Sustainable Development Goal (SDG) 11: Sustainable Cities and Communities, which emphasizes the creation of inclusive, safe, resilient, and sustainable communities through improved environmental management. The activities implemented by the Angen Bali Community encourage community participation in waste segregation, recycling, and organic waste utilization, thereby reducing waste accumulation within residential areas. The transformation of plastic bottle caps into handicraft products and the conversion of organic waste into eco-enzyme demonstrate that household waste can be managed as a valuable resource rather than being disposed of directly into landfills. Such community-based waste management practices contribute to creating cleaner neighborhoods, improving environmental quality, and strengthening local capacity for sustainable urban development.



Figure 8 show SDGs 12

The program also supports SDG 12: Responsible Consumption and Production by promoting sustainable resource utilization through the implementation of the Reduce, Reuse, and Recycle (3R) principles. Plastic bottle caps, which are commonly regarded as non-recyclable waste, are transformed into handicraft products with functional, aesthetic, and economic value, thereby extending the life cycle of plastic materials and reducing the demand for virgin resources. Likewise, organic household waste is converted into eco-enzyme through anaerobic fermentation, producing a multifunctional liquid that can be used as a natural cleaner and liquid fertilizer. These practices reflect the principles of the circular economy by minimizing waste generation, maximizing resource efficiency, and encouraging more responsible consumption and production patterns within the community.

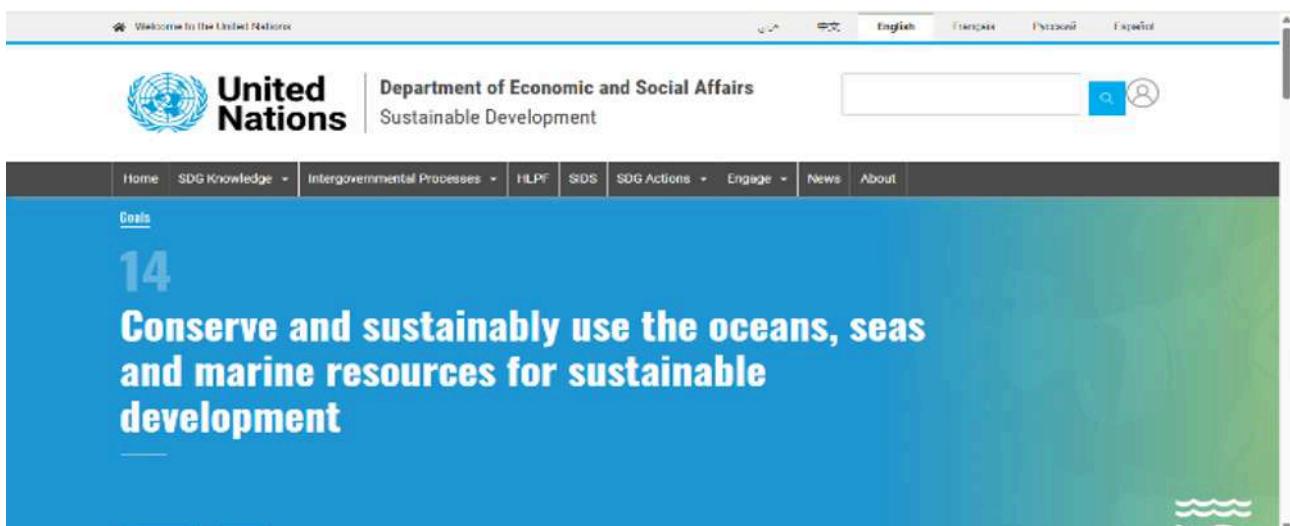


Figure 9 show SDGs 14

Furthermore, the activities contribute to SDG 14: Life Below Water, which aims to conserve and sustainably use marine resources by reducing pollution, particularly marine plastic debris.

Serangan Village is a coastal area whose environmental quality is closely connected to the health of surrounding marine ecosystems. Improperly managed plastic waste can easily enter rivers and coastal waters, threatening marine biodiversity through ingestion, entanglement, and habitat degradation. By recycling plastic waste into value-added products, the program helps reduce the amount of plastic that may eventually reach the ocean. In addition, the utilization of organic waste through eco-enzyme production minimizes household waste disposal and encourages the use of environmentally friendly alternatives to chemical cleaning products, thereby reducing the risk of water pollution. Consequently, these community-based practices contribute to protecting coastal ecosystems while promoting sustainable environmental stewardship.

Overall, the program demonstrates that community empowerment through environmental education, plastic recycling, and eco-enzyme production represents an effective strategy for supporting sustainable waste management. Beyond improving environmental awareness, these activities strengthen local participation in implementing circular economy practices and contribute directly to the achievement of SDGs 11, 12, and 14 through practical, community-based environmental action

IV. DISCUSSION

The findings indicate that the Angen Bali Community has established a community-based waste management system integrating waste segregation, plastic waste recycling, and the utilization of organic waste through eco-enzyme production. This practice not only aims to reduce waste generation but also creates added value by transforming waste into products with functional, aesthetic, and economic value. Through educational sessions, demonstrations, and hands-on training, participants gained direct experience in every stage of the recycling process, including waste segregation, shredding, washing, melting, molding, and the production of finished handicrafts. These findings suggest that effective waste management depends not only on the availability of appropriate technology but also on environmental education, active community participation, and the implementation of the Reduce, Reuse, and Recycle (3R) principles. This finding is consistent with the studies of Hulaikah and At-tanwir (2022) and Laily Khairiyati et al. (2021), which reported that recycling plastic waste can reduce environmental pollution while simultaneously generating economic value.

In addition to providing technical knowledge on waste management, the program demonstrated that experiential learning serves as an effective approach to enhancing participants' understanding of sustainable waste management practices. Through observation, interviews, demonstrations, and direct participation in the recycling process, participants acquired not only conceptual knowledge but also practical insights into the implementation of community-based waste management. This learning experience highlights the pivotal role of community engagement in fostering a sustainable waste management culture. Accordingly, the practices implemented by the Angen Bali Community may be regarded as a best practice model with the potential to be replicated by other communities facing similar waste management challenges.

Furthermore, the waste management practices implemented by the Angen Bali Community contribute to the achievement of the Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 14 (Life Below Water). Plastic waste recycling and the utilization of organic waste not only

contribute to a cleaner environment but also promote more efficient resource utilization and reduce the risk of environmental pollution, particularly in coastal areas. Therefore, participation in the Sustainable International Community Service (SICS) program provided valuable academic and practical learning experiences while reinforcing participants' understanding of the importance of collaboration between higher education institutions and local communities in advancing sustainable waste management initiatives. These findings suggest that the practices developed by the Angen Bali Community may serve as a valuable reference for future community service programs and similar initiatives in other regions facing waste management challenges.

V. CONCLUSION

The community-based waste management practices implemented by the Angen Bali Community demonstrate that the integration of plastic waste recycling and eco-enzyme production can effectively support sustainable environmental management while promoting resource efficiency and environmental awareness. Through observation, educational sessions, demonstrations, and hands-on training, participants gained comprehensive insights into the practical implementation of sustainable waste management and its contribution to achieving SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 14 (Life Below Water). Furthermore, the practices developed by the Angen Bali Community represent a valuable best practice that may serve as a reference for future community service programs and inspire the adoption of similar community-based waste management initiatives in other regions. Continued collaboration between higher education institutions and local communities is expected to strengthen environmental education and promote the long-term sustainability of community-based waste management practices.

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