TRANSFORMING TRASH INTO TREASURE: WASTE VALORIZATION PRACTISE IN SUSTAINABLE PRODUCT DEVELOPMENT

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ABSTRACT

This study explores the potential of waste valorization as a strategy for promoting sustainable development within a circular economy framework among Indonesian migrant workers in Malaysia. The primary objective is to develop practical approaches for transforming domestic waste into high-value, environmentally friendly products, thereby addressing resource underutilization and environmental concerns. The methodology involves participatory training sessions to enhance community members' skills in waste management, product design, and entrepreneurship, supported by qualitative assessments of attitudes and quantitative measurements of raw material input and estimated production costs. The results indicate that 84% of participants felt the program effectively addressed relevant societal issues, 81% actively participated in and benefited from the activities, and the infrastructure support facilitated the production of eco-friendly products. Additionally, participants demonstrated increased knowledge, their skill levels improved from basic to medium, and they gained confidence in producing sustainable products, which can potentially be expanded to local and international markets. The study concludes that waste valorisation is a promising approach for fostering a circular economy and promoting sustainable development, emphasising the importance of continuous training, infrastructure development, and market access.

Keywords: Waste Valorization, Sustainable Development, Circular Economy, Migrant Workers, Eco-friendly Products.

1. INTRODUCTION

Utilization of unused resources, such as domestic waste and used goods, is a strategic approach to achieving environmental sustainability and empowering communities economically (Amrina *et al.*, 2021; Kherwal *et al.*, 2024). Sustainable entrepreneurship, defined as the pursuit of economic value while considering social and environmental impacts, is crucial in addressing the problem of underutilised resources (Jayasinghe *et al.*, 2021). Indonesian migrant workers (TKI) in Malaysia, the focus of this Community Service activity, are involved in economic activities that are based on sustainability and have significant potential to create positive social, economic, and environmental impacts. One of the TKI organisations in Malaysia is Pertubuhan Masyarakat Indonesia (PERMAI) Pulau Pinang, an organisation comprising Indonesian migrant workers in Malaysia. This organization aims to strengthen solidarity among its members while improving their welfare. As a community with limited access to resources and entrepreneurship training, PERMAI faces significant challenges in maximising the potential of its members, particularly in developing sustainable and environmentally friendly businesses.

PERMAI Pulau Pinang is a non-profit organization formed by Indonesian workers in Pulau Pinang, Malaysia. Established in 2005, this organisation has grown into a solid community with over 300 active members, primarily from the informal sector, including domestic helpers, construction workers, and factory workers. The majority of its members are individuals with lower secondary education levels and have limited access to entrepreneurship skills training. The Social and Economic Conditions of PERMAI members can be described as follows:

- Income: Most PERMAI members have an average monthly income of RM1,500 to RM2,000, which is primarily used for basic living expenses and remittances to families in Indonesia.
- Access to Training: The lack of access to entrepreneurship training makes it difficult for PERMAI members to develop independent businesses despite many of them possessing basic skills such as sewing, cooking, or crafting.
- Environmental Awareness: Awareness of sustainability issues and waste management remains low despite the community producing significant amounts of domestic waste.

Meanwhile, PERMAI members have potential abilities which can be described as follows:

- PERMAI members have a high spirit of cooperation and are open to opportunities for skill improvement.
- Many members possess basic skills in the production of goods, such as handicrafts and culinary arts, but require further training to enhance the quality and added value of their products.

- The strategic location of Penang Island, combined with its international market, provides excellent opportunities for the development of environmentally friendly product-based businesses.

At the upstream stage, people often produce domestic waste, such as plastic, paper, and used clothing, most of which are not managed optimally. Poor waste management can have negative impacts on public health and the environment (Geissdoerfer *et al.*, 2017), (Mishra *et al.*, 2024). This waste often ends up in landfills without further processing (Mohapatra *et al.*, 2024), (Tahir, 2024). Meanwhile, at the downstream stage, there has been no independent business or business unit that utilises used goods to create simple handicrafts. Therefore, practical training is needed to create or produce products with attractive designs and high-selling value so that they can compete in local and international markets (Balaganesh *et al.*, 2023), (Mondal *et al.*, 2024), (Dhar *et al.*, 2021), (Umesh *et al.*, 2024), (Hasibuan and Hidayati, 2018). Simple and effective recycling methods can help people in communities to turn waste into high-value products (Reddy *et al.*, 2023), (Karim *et al.*, 2025), (Kalkanis *et al.*, 2022), such as bags, home decorations, and other functional items. Table 1 presents the challenges and opportunities that PERMAI members face.

Table 1. Challenges and Potential Abilities of PERMAI Members

	Challenges	Potential Abilities
1.	Lack of Training and Knowledge: Most PERMAI members lack adequate knowledge about waste management and sustainability concepts. They also lack an understanding of modern entrepreneurial strategies, including branding, digital marketing, and business management.	Human Resources: PERMAI members are resilient individuals with basic skills that can be further developed.
2.	Limited Access to Capital: Access to business capital is severely limited, as many members lack the necessary legal documents in Malaysia to apply for business loans.	Raw Material Resources: Domestic waste and used goods generated by the community can be processed into high-value products.
3.	Infrastructure Limitations: The lack of supporting facilities such as recycling tools or training workshops makes it difficult for members to start or develop sustainability-based businesses.	Community Support: Strong solidarity among PERMAI members is a valuable form of social capital that drives empowerment programs.
4.	Lack of Market Network: The lack of connection with the wider market makes it difficult for PERMAI community products to gain a significant market share.	Market Opportunities: Eco-friendly products have great potential to penetrate international markets, especially in areas such as Penang, which has access to ports and export markets.

Based on the situation analysis above, the main problems that need to be solved through this program are:

1. Lack of Knowledge and Skills: PERMAI members require intensive training in waste management, recycling, and the production of environmentally friendly goods with innovative designs.
2. Lack of Sustainability Approach: A program is needed that aims to instil a sustainable mindset in the management of businesses and the daily lives of PERMAI members.

This program aims to improve the skills of PERMAI members in managing waste and unused goods into high-value products. It helps PERMAI members create environmentally friendly products that are competitive in local and international markets. Then, it instils sustainability awareness among community members. This program will be implemented through a series of activities, including training in the production of recycled engineering products and environmentally friendly goods, as well as environmental awareness campaigns to promote sustainable lifestyles within the PERMAI community.

2. METHOD

Recent studies have underscored the importance of participatory approaches in community-based waste valorisation practices (Geng *et al.*, 2021). Additionally, integrating quantitative assessments enables the measurement of tangible improvements in community behaviour and economic indicators (Santoro *et al.*, 2023). The combination of qualitative insights with quantitative metrics provides a comprehensive understanding of intervention impacts, ensuring findings are both scientifically rigorous and practically relevant (Irgin and Bilki, 2024; Lawrence *et al.*, 2023). The implementation procedure can be divided into several sequential phases in Figure 1 (Amrina *et al.*, 2024):

Figure 1. Community Development Program Activity Steps

1. **Interviews.** Initial interviews were conducted via video meeting to assess PERMAI members' current knowledge, attitudes, and practices regarding waste valorisation practices (Andre et al., 2021). This phase involves asking questions to capture environmental awareness, entrepreneurial capacity, and quantities of waste production.
2. **Training.** Based on the interviews, tailored training modules will be delivered over four sessions, covering waste introduction, product design from waste, and basic entrepreneurship skills. The training materials were developed following best practices from recent studies (Kottala et al., 2020; Lee et al., 2021) and delivered through participatory workshops, demonstrations, and field exercises, utilising local resources and technologies.
3. **Evaluation.** After training, a survey was conducted to assess changes in participants' knowledge and skills, as well as the effectiveness of the training program (Kumar et al., 2020). Quantitative data from surveys was analyzed using descriptive statistics to determine the effectiveness of the training program (Sharma et al., 2019). Qualitative data from the interviews will be subjected to thematic analysis to assess changes in participants' knowledge and skills, following the methodology of Braun and Clarke (2006).
4. **Program Sustainability.** Post-training, community members undertake small-scale production of eco-friendly products utilizing recycled waste. This process is monitored through online meetings, and production outputs are documented systematically.

3. RESULTS AND DISCUSSION

The results of implementing the Community Development Program demonstrated significant achievements in program implementation, evaluation, and learning outcomes. Here is a brief overview of the results achieved:

Documentation of program implementation.
The documentation of Community Development Program activities includes detailed records of project activities, community engagement, resources utilized, and outcomes achieved. This documentation provides a comprehensive overview of the program's implementation process.

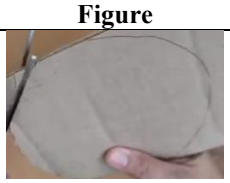
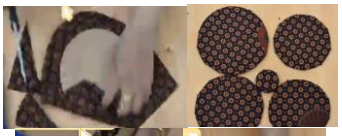
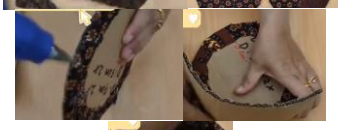
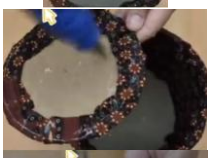
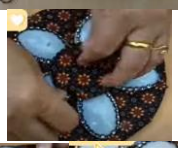
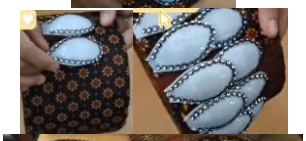
During the training in waste valorization practice in sustainable product development, the participants are educated about the following:

a. Definition and steps of waste management process
b. Waste valorization application
c. Practical waste valorization in sustainable product development (participant conducts product manufacturing practice)

Figure 3. Materials Needed

Table 2 outlines the sequential steps for manufacturing the product utilizing waste materials. The process begins with the fabrication of basic components, including the base, walls, and lid, where the shapes are cut accordingly. The base is then covered with cloth and adhered with glue, with the cloth pattern cut following the base dimensions. Subsequently, glue is applied to the edges of the circular base to secure it to the product's walls. The inner surface is covered with a smaller circle also glued in place. Decorated spoon heads are cut and embellished with simple accessories, which are then glued onto the lid. This process emphasizes the systematic use of recycled materials to produce aesthetically pleasing and commercially viable products, demonstrating practicality and creativity in sustainable upcycling practices.

Table 2. Steps For Making The Product

No.	Steps	Figure
1	Making Basic Product Parts (Base, Walls, and Lid). Cut according to the basic shape of the product (for example, a circular base with a specific diameter, a lid with a certain diameter, and the product walls in a rectangular shape with a length that fits the circumference of the circle).	
2	The process of covering the base parts with cloth: glue the base and cloth together, cut the cloth pattern following the base part pattern with a small amount of extra size	
3	Apply glue to the edge of the circle so that it can be attached to the body/wall of the cardboard.	 
4	Glue the circle with a smaller diameter (the one with the cloth attached) to cover the inside.	
5	Cut out the spoon heads and decorate them with simple accessories.	
6	Glue 5 decorated spoons on the lid, then glue a circle with a diameter of about 5cm on top.	
7	Stick the decorated spoon head to the wall of the product, stick it in a circular motion and make two stacks.	
8	Final Product	

The estimated production cost of the waste valorisation products comprises several key components, including raw materials (recycled household waste), supporting materials (glue, cloth, and simple accessories), and labour costs incurred during the manufacturing process. Based on preliminary analysis, raw material costs are relatively low due to the utilization of locally available and freely accessible waste materials, while supporting materials constitute the primary expenditure. Labour costs are also minimal, given the straightforward nature of the production process, which can be performed individually or in small groups. Overall, the estimated cost per unit ranges from RM10 to RM15, indicating a potentially favourable profit margin when marketed at scale and providing opportunities for product development with higher added value and increased production efficiency.

Program Implementation Evaluation.

The evaluation of program implementation assesses the achievement of program objectives, community satisfaction, and the overall impact on the target beneficiaries. This evaluation helps determine the success of Community Development Program activities and their alignment with the initial goals. Total participants are 20 persons. Table 5 shows the percentage distribution of answers from twenty participants.

Table 5. Questionnaire Result – Comparison Between Expectation and Performance

No.	Question	Measurement Value	1	2	3	4
1	The material for community service activities addresses existing societal problems.	Expectation	3%		9%	88%
		Performance		3%	22%	75%
2	The community service method used is appropriate to the theme and objectives of the service program.	Expectation	3%		22%	75%
		Performance		3%	25%	72%
3	Facilities and infrastructure supporting service activities, such as designated places or buildings, tools and materials, and other necessary support, are adequate.	Expectation		3%	19%	78%
		Performance			28%	72%
4	The team implementing the service program looks united in carrying out activities.	Expectation		3%	16%	81%
		Performance		3%	19%	78%
5	The team implementing the service program is competent with the material provided	Expectation		3%	16%	81%
		Performance		3%	16%	81%
6	The implementing team is excited about packaging the service program	Expectation		3%	9%	88%
		Performance		3%	13%	84%
7	The community is enthusiastic about participating in service activities	Expectation		6%	9%	84%
		Performance		6%	9%	84%
8	The community feels the benefits of the service program provided	Expectation		3%	6%	91%
		Performance		3%	13%	84%
9	The community is very interested and enthusiastic about service activities	Expectation	3%	3%	13%	81%
		Performance	3%	3%	19%	75%
10	The community as a whole is satisfied with the community service activity program that has been carried out.	Expectation		6%	19%	75%
		Performance		6%	19%	75%
11	The Community Service Program is in line with what the community expects	Expectation		6%	13%	81%
		Performance		6%	9%	84%
12	The terms of the service program are following what the community expects	Expectation	3%	3%	13%	81%
		Performance	3%	6%	16%	75%

Based on the evaluation in Table 5, the majority of respondents gave a score above 3, indicating that they are satisfied. However, if you look at each question criterion in more detail, several areas need improvement because they are slightly below expectations. For example, related to questions 1, 2, 4, 6, 11, and 12. Some improvements are suggested, such as :

a. A practical form of collaboration involves forming multi-stakeholder working groups to co-develop and pilot innovative waste management solutions, as well as organizing joint workshops and training sessions to foster knowledge exchange. Additionally, establishing formal partnerships for market access and policy support can further strengthen program sustainability and community impact.
b. Designing interactive and varied service program designs such as case studies, simulations, role plays, group discussions and team projects

The results of the Community Development Program implementation are closely linked to learning outcomes and output achievements. By reflecting on the program's outcomes, participants can identify the knowledge gained, skills developed, and the impact of their contributions on the community. This reflection enhances the learning experience and contributes to personal and community development. Based on observations of practical assessments by 20 participants, it can be stated that there was an increase in skills from a score of 1 (basic skill) to a score of 2 (medium skill). With consistent practice, they can achieve high-level skills (score 3). Even with the innovations they make, it is possible that in the future, they can become experts (score 4).

In addition to the mandatory outcomes, Community Development Program activities lead to increased awareness among participants of waste valorisation practices in creating sustainable product development. These additional accomplishments demonstrate the program's positive impact and the participants' commitment to community welfare. Initially, the communities have a minimum or no understanding of the issues related to sustainability, waste management, or environmental impact. They lack basic knowledge and show little concern or interest in adopting environmentally friendly practices (score 1). Based on the questionnaire answered, they have some understanding of sustainability issues and recognize their importance. However, their engagement and proactive behaviour toward sustainable practices are limited, often requiring additional motivation or education to take action (score 2). Soon, they may influence others and demonstrate responsible behaviour in sustainable activities (score 3). Furthermore, they

can serve as role models and advocates for sustainable development, contributing to widespread cultural change (score 4).

Program Sustainability

The implementation of the community development program demonstrated significant potential for ensuring long-term sustainability through multi-faceted strategies. Firstly, the program successfully fostered increased community awareness of waste valorisation and sustainable product development. Participants demonstrated an improved understanding of waste management principles and environmentally friendly practices, progressing from minimal or no prior knowledge to a proactive engagement level. Self-assessment and observation revealed an improvement in participants' skills, as evidenced by practical assessments that showed an upward trend from a basic skill level (score 1) to a medium skill level (score 2), with the potential to achieve higher competency through continued practice. Secondly, community engagement was strengthened by establishing formal partnerships with local stakeholders, including local authorities and market entities. These partnerships enhance access to market channels, facilitate promotional activities, and support policy advocacy, thereby fostering program sustainability. Thirdly, the program incorporated capacity-building activities, including training sessions on waste management, upcycling techniques, and entrepreneurial skills, such as branding and marketing. These training sessions aimed to develop participants' competencies in producing high-value products suitable for local and international markets.

Furthermore, community members' resilience, cooperation, and their existing social capital serve as a foundation for sustained collective action. The presence of a cohesive community structure mitigates risks associated with program dependency on external support, promoting self-reliance and ongoing innovation. Lastly, the program's strategic focus on environmentally sustainable product manufacturing aligns with the local market opportunities in Penang Island, leveraging its international connectivity to access global supply chains. This market potential supports the economic sustainability of community-initiated enterprises.

4. CONCLUSION

The implementation of the community development program has yielded significant tangible outcomes, reflecting its effectiveness in promoting sustainable waste valorisation practices. Evaluations showed that 84% of participants felt the program addressed relevant societal issues, while 81% actively participated and benefitted from the activities. Infrastructure support, including facilities and tools, was rated as adequate by 75% of respondents, facilitating the smoother execution of activities. Moreover, practical skill assessments revealed notable improvements, with participants progressing from a basic skill level (score 1) to a medium level (score 2), indicating increased competency and confidence in producing eco-friendly products from waste materials. These results underscore the program's success in enhancing community engagement, infrastructure, and individual capabilities, which collectively contribute to achieving the Sustainable Development Goals.

The positive shifts in knowledge, skills, and community participation demonstrate the potential for long-term impact. However, to optimize these outcomes, continuous training, market access support, and policy integration are essential. Sustaining and scaling the program can further empower communities to adopt environmentally friendly practices and develop sustainable enterprises, ultimately contributing to environmental preservation and regional economic growth.

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