

Collaborative Waste Management Initiatives with Local Communities in Sidamukti Village, Pandeglang, Banten

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Abstract Global waste generation continues to intensify environmental pollution and contribute to climate change, with municipal solid waste projected to increase substantially by 2050. In Indonesia, rapid urbanization has resulted in approximately eight million tons of waste produced daily in major cities, highlighting the urgent need for improved waste management systems and greater public awareness. In Banten Province – particularly in Sidamukti Village, a coastal area in Pandeglang Regency – these challenges are further exacerbated by insufficient waste management practices. To address these issues, Universitas Trisakti implemented a Community Service Program (PKM) in Sidamukti Village aimed at strengthening waste management practices and increasing community knowledge of health and hygiene. Program activities included health and hygiene (PHBS) awareness sessions, shell-craft training, eco-enzyme production, composting, and the establishment of a waste bank. The methods employed consisted of workshops, hands-on training, and community engagement activities. A paired-sample t-test was used to assess the effectiveness of the interventions. The results showed significant improvements in PHBS practices as well as in participants' skills in crafting, eco-enzyme production, composting, and waste bank management. These findings demonstrate the effectiveness of the PKM initiative in enhancing community-based waste management and promoting environmentally responsible practices.

1. INTRODUCTION

Global waste production continues to intensify environmental problems, including pollution, habitat degradation, and climate change. In 2023, the world generated approximately 2.3 billion tons of municipal waste, a figure projected to increase by two-thirds by 2050 (United Nations Environment Programme, 2024). Waste contributes an estimated 1,580 billion tonnes of CO₂e – about 3.2% of global CO₂ emissions (Ritchie & Roser, 2020). As a result, waste management and recycling initiatives are increasingly framed within global and

multisectoral perspectives.

Indonesia faces comparable challenges in managing household and industrial waste (Maulani et al., 2024), further exacerbated by rapid urbanization. Daily waste generation in major Indonesian cities has reached eight million tonnes (Aprilia, 2021). Limited public awareness regarding environmental hygiene also heightens health risks and disease transmission (Margaretta et al., 2023). Addressing these issues requires integrated approaches that combine household-level practices with broader community

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Figure 1 . Waste management initiatives in Sidamukti Coastal Village, Sukaresmi District, Pandeglang, Banten

initiatives (Nugrahini et al., 2023) and promote collaboration among academia, government, communities, and the private sector (Nurhaida et al., 2024).

Despite ongoing efforts, proper waste disposal practices remain inconsistent across Indonesia (Sinaga et al., 2023). Sidamukti Village in Pandeglang Regency, Banten, exemplifies these challenges. An overview of the waste management challenges and community-based initiatives implemented in Sidamukti Coastal Village is presented in Figure 1, providing contextual background for the implementation of the community service program. Although situated in a coastal area, the village struggles to manage household, agricultural, and marine waste—particularly accumulations of clam shells along the shoreline (Nurhaida et al., 2023). Human activities such as tourism, farming, fishing, and port operations have contributed to environmental degradation, including mangrove loss, coastal erosion, river sedimentation, and increased water turbidity (Ati et al., 2023; Maesaroh et al., 2013).

Previous studies highlight the importance of education, training, and community engagement in improving waste management practices. Azizah & Rizky (2022) showed that the Bank Sampah Berkah program in Tugu Selatan Village, Jakarta, enhanced both environmental cleanliness and residents' economic empowerment through community-based waste collection. Similarly, Damayanti et al. (2020) trained PKK mothers in Kalianyar Village to reuse inorganic waste for household storage, improving their knowledge and skills. Firdayetti et al. (2024) demonstrated that incorporating eco-enzymes into waste

bank operations increased composting efficiency and reduced carbon footprints, yielding ecological and social benefits.

Behavioral interventions also play an important role. Halimatussadiah et al. (2017) found that students' waste-related knowledge significantly influenced environmentally friendly behaviors, particularly among female students and those in science programs. At the community level, Nugrahini et al. (2023) transformed household and agricultural waste into valuable products in Jurangjero Village, Central Java, emphasizing the need for village administration support to sustain such initiatives. Sinaga et al. (2023) improved hygiene and healthy living awareness in Tirtayasa Village, Serang, through educational communication grounded in behaviorism theory, leading to better waste disposal practices, improved access to clean water, and enhanced local coordination. Ruliana et al. (2019) further emphasized that participation, information sharing, and community knowledge are essential for successful waste separation in Tugu Village, Depok.

Building on these insights, Universitas Trisakti implemented the Community Service Program (PKM) in Sidamukti Village. Conducted in collaboration with village officials, elementary schools, posyandu cadres, PKK mothers, and local residents—with support from a CSR initiative—the program aims to strengthen community capacity in waste processing and management. Activities include hygiene awareness sessions for children, training in shell-waste crafts, eco-enzyme production, composting, and the establishment of a household waste bank to convert waste into economically valuable products.

2. METHOD

The Community Service Program (PKM) in Sidamukti Village, Pandeglang Regency, was implemented from January to March 2024. Prior to the intervention, a pre-assessment was conducted to evaluate the community's knowledge, practices, and challenges related to household waste management. The findings informed the design of activities tailored to the specific needs of the village.

A total of 100 participants took part in the program, consisting of elementary school students, PKK mothers, posyandu cadres, and local residents. The demographic profile of participants is presented in Table 1.

The methods employed in the implementation of the PKM activities are described as follows:

- a. **Mentoring**
This method aimed to shift the mindset of community cadres toward converting household waste into economically valuable products. Through mentoring, cadres received guidance, motivation, and technical support to adopt improved waste management practices.
- b. **Participatory Rural Appraisal (PRA)**
PRA was used to foster a sense of responsibility among community members toward environmental cleanliness and health. By involving residents directly in decision-making and program implementation, this approach encouraged collective ownership and strengthened community engagement.
- c. **Awareness Sessions**
Awareness sessions were delivered through two-way communication with children and public lectures for adults. These sessions provided foundational knowledge on the importance of proper waste management and its environmental impacts.
- d. **Training**
Hands-on training was conducted on compost

production, eco-enzyme creation, and shell-craft making. Through these practical activities, participants developed concrete skills for transforming household waste into useful and potentially marketable products.

- e. **Discussion and Q&A**

Interactive discussions and question-and-answer sessions were facilitated to encourage critical thinking and creativity. These exchanges allowed participants to express ideas, provide feedback, and contribute to the planning and enrichment of the waste bank program.

- f. **Evaluation**

Program effectiveness was assessed through questionnaires distributed via Google Forms. The evaluation measured participants' understanding of the material presented and their ability to apply the concepts in their daily waste management practices.

3. RESULT AND DISCUSSION

3.1 Participant Demography

Table 2 summarizes the participants involved in the PKM activities in Sidamukti Village, including gender, age, and education level.

3.2 Field observations

Field observations in Sidamukti Village revealed several pressing waste management concerns. The majority of waste consists of household organic materials such as food scraps, tree branches, dry leaves, and animal waste. Inorganic waste—particularly plastic—poses an even greater challenge due to its slow decomposition, contributing to widespread accumulation throughout the village. Additionally, large quantities of clam shell waste were observed, further compounding waste management difficulties.

Current waste handling practices rely largely on

Table 1 . The demographic profile of participants

Category	Number	Percentage (%)	Details
Elementary students	40	40%	Age 7–12 years
PKK mothers	20	20%	Age 25–50 years
Posyandu cadres	25	25%	Age 20–55 years
Residents	15	15%	Age 18–60 years, including traders, farmers, fishers
Total	100	100%	

Table 2 . Participants' demography of the PKM

Activity	Participant	Number	Gender (M/F)	Age (Years)	Education
Socialization PHBS	Elementary students	40	18 / 22	7–12	Elementary School
Craft Training	PKK mothers	20	0 / 20	25–50	High School–Vocational
Craft Training	Posyandu cadres	25	0 / 25	20–55	High School–Vocational
Craft Training	Local residents	15	0 / 15	18–60	Elementary–High School
Eco-Enzyme & Compost Training	Local residents	25	10 / 15	18–60	Elementary–High School
Waste Bank Establishment	Local residents	30	15 / 15	18–60	Elementary–High School

Note: Some participants joined multiple activities; total unique participants = 100

independent methods, such as open burning and uncontrolled dumping, which pose significant environmental and health risks. Plastic waste in particular often ends up in rivers and coastal waters, as some residents continue the practice of disposing of waste directly into water bodies. Similar findings have been reported by Ratnaningsih et al. (2020) and Satori et al. (2020), both emphasizing the importance of developing community-based waste management systems.

Addressing these challenges requires sustained efforts to raise awareness of proper waste handling practices. Effective waste management must begin at the individual, household, and village levels to reduce environmental degradation and mitigate health risks associated with improper disposal.

3.3 Focus group discussion with village officials and community leaders

Several meetings were conducted with village officials and community leaders to obtain information about local conditions and government plans for improving waste management systems. The officials of Sidamukti Village expressed strong support for the PKM activities, noting that these efforts align with the village's medium-term goals to strengthen community-based waste management.

The discussions concluded that PKM activities would prioritize the use of appropriate technologies to process organic, inorganic, and marine waste—particularly clam shells. Village representatives emphasized the need for continuous guidance and collaboration from external partners, especially academic institutions, to help address persistent waste and marine residue issues. Marine waste such as clam shells remains particularly challenging to process and requires further innovation.

3.4 Awareness-raising to encourage early childhood to maintain a clean and healthy environment

Students' waste-related behaviors play a crucial role in establishing sustainable waste management practices at the school level (Ardoin & Bowers, 2023; Halimatussadiyah et al., 2017; Siska & Suryana, 2022; Solekah & Jumriyah, 2023). In response, the PKM team conducted an awareness session for elementary school students to encourage early childhood engagement in maintaining a clean and healthy environment.

The session focused on helping children understand the importance of cleanliness and health within their surroundings. Interactive activities, storytelling, and child-friendly demonstrations were used to match their developmental levels. Through the awareness session, students learned basic hygiene practices such as proper handwashing, waste disposal, and maintaining a clean environment. They also gained an understanding of the relationship between hygiene and health, recognizing how their actions contribute to a safer environment for themselves and others. This early learning experience serves as a foundation for lifelong habits that support personal well-being and environmental stewardship. The

implementation of clean and healthy living behavior (PHBS) education for elementary school students is visually illustrated in Figure 2.



Figure 2 . Education for early childhood to maintain clean and healthy environments

3.5 Training on craft-making using clam shells

Recent studies show growing attention to local and small-scale environmental initiatives, particularly do-it-yourself (DIY) practices (An Nisaa et al., 2023; Carney & Déméné, 2022; Hidayati et al., 2021). To address the accumulation of clam shell waste in Sidamukti Village, the PKM team conducted training sessions for PKK mothers, posyandu cadres, and other community members on producing handicrafts from shells. This activity aimed to equip participants with the skills and knowledge needed to repurpose discarded clam shells into aesthetically appealing and economically valuable creations.



Figure 3 . Documentation of the training session crafting with shells

The training introduced participants to several key aspects of clam shell utilization. First, participants learned effective methods for cleaning and preparing clam shells, ensuring they were properly sanitized and ready for crafting. Demonstrations were then provided on techniques for shaping and carving the shells, enabling participants to manipulate them into various forms and textures. Instruction on design and decoration—such as painting, drawing, and engraving—helped participants enhance the artistic quality of their work. Finally, guidance on assembly and finishing techniques allowed them to create larger artworks or functional items with a polished, professional appearance.

Overall, participants showed high levels of enthusiasm throughout the activity. The results of the training were reflected in the diverse range of products they created, including necklaces, brooches, bracelets, curtains, decorative hats, lamps, and other handcrafted items. The training process and participants' active involvement in shell craft production are documented in Figure 3.

3.6 Transforming organic waste into eco-enzymes and compost

Organic waste can be converted into valuable products such as eco-enzymes and compost (Marlinda et al., 2023; Sari et al., 2024; Sumiadji et al., 2022; Pungut et al., 2023; Wikaningrum & El Dabo, 2022). To promote this practice in Sidamukti Village, the PKM team collaborated with local community members to conduct training sessions featuring hands-on demonstrations of producing eco-enzymes and compost from household organic waste.

Eco-enzyme production involves fermenting fruit scraps with brown sugar or molasses and water in airtight containers for several weeks. During fermentation, naturally occurring enzymes and microorganisms in the fruit peels break down sugars, resulting in a multipurpose liquid cleaning solution. After the fermentation process, the mixture is strained and can be diluted for use as a household cleaner or natural insect repellent. By making eco-enzymes, participants can reduce food waste while decreasing reliance on chemical-based cleaning products, thus promoting more sustainable household practices.



Figure 4. (a) The ingredients and tools to make eco-enzyme and compost; (b) Organic waste to be turned into compost

Composting organic waste requires the collection of biodegradable materials such as food scraps and yard waste, which are layered in a compost bin or designated

pile. Maintaining a balanced ratio of green and brown materials, ensuring proper moisture, and regularly turning the pile to introduce oxygen are essential steps in achieving effective decomposition. Monitoring temperature also helps optimize microbial activity. Although composting requires time and consistent effort, it produces nutrient-rich compost that improves soil health and reduces the volume of organic waste sent to open dumps. This makes composting a practical and environmentally friendly approach to managing household organic waste. The materials, tools, and organic waste utilized in the production of eco-enzymes and compost are shown in Figure 4.

3.7 Managing household waste through the establishment of a waste bank

Many scholars note that establishing a waste bank represents a concrete form of community participation in waste management. Ratnaningsih et al. (2020) demonstrate that waste bank training increases community involvement in implementing the 3R principles, while Nugroho (2022) shows that economic incentives offered by waste banks encourage greater public engagement. In addition, Satori et al. (2020) emphasize that community participation is essential for ensuring the long-term sustainability and contribution of waste banks to local waste management systems. Together, these findings suggest that waste banks embody collective awareness and shared responsibility in managing household waste.



Figure 5. The establishment of a waste bank initiated by the PKM team together with the community

To expand this initiative in Sidamukti Village, the PKM team facilitated the establishment of waste banks through community assessments, comprehensive planning, and resource mobilization—including securing funding and necessary infrastructure. Working closely with residents,

the team raised awareness, promoted participation, and ensured alignment with local regulations. Educational activities and outreach programs further encouraged households to practice waste separation and recycling, strengthening their sense of ownership and empowerment.

Through this community-driven system, households deposit recyclable or reusable waste in exchange for incentives, fostering active participation and generating environmental benefits such as reduced landfill waste and greater resource conservation. Waste banks also provide social and economic advantages by creating job opportunities, generating income from recycled materials, and empowering the community through education. Continuous monitoring and evaluation by the PKM team allow for the assessment of progress, the measurement of impact, and the refinement of strategies, thereby supporting sustainable waste management and environmental conservation efforts at the village level. Community participation in managing household waste through the establishment of a waste bank is illustrated in Figure 5.

3.8 Assessment of the programs

To evaluate the effectiveness of the interventions, paired-samples t-tests were conducted to examine changes in participants' scores before and after each activity. This statistical method compares the means of two related measurements to determine whether an intervention produces a significant difference. The analyses in Table 3 summarize the outcomes for five interventions, each designed to improve specific knowledge and skill areas. The results indicate whether the activities produced meaningful improvements based on the t-statistics and p-values.

The paired-samples t-test results show substantial and statistically significant improvements across all evaluated interventions.

For Pair 1: PHBS, the mean score increased from 59.63 before the intervention to 81.25 afterward, with a t-statistic of 24.98 and a p-value of 0.000. This significant change demonstrates the effectiveness of the activity in improving health-related knowledge and practices.

For Pair 2: Craft-Making from Shells, the mean score rose from 53.50 to 77.50, accompanied by a t-statistic of

24.00 and a p-value of 0.000. These results indicate a strong positive impact of the craft-training activity, reflecting considerable improvement in participants' skills.

For Pair 3: Making Eco-Enzymes, the mean score increased sharply from 47.60 before to 76.60 after the intervention. The t-statistic of 35.52 and a p-value of 0.000 highlight the highly significant effect of the eco-enzyme training.

Similarly, Pair 4: Making Compost showed meaningful improvements, with mean scores rising from 62.60 to 78.60. The t-statistic of 24.79 and p-value of 0.000 confirm that the compost-making training substantially enhanced participants' understanding and abilities.

For Pair 5: Establishing a Waste Bank, the mean score increased from 35.00 before the intervention to 78.33 afterward. The t-statistic of 33.96 and a p-value of 0.000 indicate a highly significant impact, showing major improvements in participants' knowledge and engagement related to waste bank management.

Overall, the results demonstrate strong positive effects of all interventions on participants' knowledge, skills, and behaviors. The large negative t-values and p-values below 0.05 confirm statistically significant improvements across all activities. These findings align with previous studies showing that community training and active participation effectively strengthen local environmental management (Ratnaningsih et al., 2020; Satori et al., 2020).

4. CONCLUSION

Based on the outcomes of the activities and the evaluation results, several conclusions can be drawn. The Community Service Program (PKM) in Sidamukti Village successfully improved participants' knowledge and awareness related to waste management. The training activities – including awareness sessions for elementary students, craft-making using clam shells, eco-enzyme and compost production, and the establishment of a waste bank – effectively enhanced participants' understanding and practical skills. As a result, participants are more likely to adopt improved waste management practices in their daily lives, such as proper segregation, recycling, and composting, which may foster long-term positive changes in individual and community behavior. Increased awareness among participants may

Table 3 . Results of paired-sample t-tests for intervention effectiveness

Paired Sample t-test	Condition	N	Mean	Std. Deviation	df	t	sig. (2-tailed)
Pair 1: PHBS	Pre-test	40	59.63	7.20	39	-24.98	0.000
	Post-test	40	81.25	2.19	39		
Pair 2: Make Crafts from Shells	Before	20	53.50	2.35	19	-24.00	0.000
	After	20	77.50	2.56	19		
Pair 3: Making Eco-enzymes	Before	25	47.60	4.36	24	-35.52	0.000
	After	25	76.60	2.38	24		
Pair 4: Making Compost	Before	25	62.60	2.55	24	-24.79	0.000
	After	25	78.60	2.29	24		
Pair 5: Establishing Waste Bank	Before	30	35.00	5.09	29	-33.96	0.000
	After	30	78.33	2.40	29		

p < 0.05: Statistically significant difference; *p* > 0.05: No statistically significant difference

also encourage knowledge sharing within the community, contributing to broader environmental benefits and more sustainable waste management practices. To maintain continued effectiveness, it is recommended that the program undergo regular evaluation to monitor knowledge retention, participant satisfaction, and behavioral changes over time. The program should also remain adaptable to emerging community needs, technological developments, and evolving waste management policies. By sustaining community engagement and updating program content as required, the PKM initiative can continue to empower local residents and promote long-term environmental stewardship.

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CONFLICT OF INTERESTS

The authors declare no conflicts of interest. All co-authors have reviewed and approved the content of this manuscript, and no financial interests are involved. This submission is original and is not under consideration by any other publication.

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