



Zero-waste strategy through the empowerment of PKK Ecomitra Wage Sidoarjo in sustainable waste management

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ABSTRACT

The increasing volume of household waste in densely populated residential areas is a major challenge for urban environmental management. Limited waste management systems and low household-level waste-sorting practices lead to the accumulation of organic waste, which could cause environmental pollution. Therefore, a sustainable waste management strategy based on community participation is needed. This community service program aims to implement and evaluate a zero-waste strategy by empowering the PKK Ecomitra group in Wage Village, Sidoarjo, through the use of appropriate technologies, including a Dekomposer Dua Sisi (Dedisi) and biopore holes, for processing household organic waste. The program was implemented using a Participatory Action Research (PAR) approach that actively involved partners in planning, socialization, training, technology application, and evaluation. Evaluation was conducted through pretest and posttest methods on 15 indicators of participant knowledge and attitudes. The results showed a significant increase in understanding of the fermentation process, waste sorting skills, awareness of the zero-waste concept, and the use of biopore holes. The overall program achievement rate exceeded 80 percent of the set target. These results indicate that a zero-waste strategy based on collective community decisions and the application of simple technologies is effective in increasing household waste management capacity and behavior, and in supporting the achievement of SDGs 12 and 13.

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ABSTRAK

Peningkatan volume sampah rumah tangga di kawasan permukiman padat penduduk menjadi salah satu tantangan utama dalam pengelolaan lingkungan perkotaan. Keterbatasan sistem pengelolaan sampah dan rendahnya praktik pemilahan sampah di tingkat rumah tangga menyebabkan akumulasi sampah organik yang berpotensi menimbulkan pencemaran lingkungan. Oleh karena itu, diperlukan strategi pengelolaan sampah yang berkelanjutan berbasis partisipasi masyarakat. Program pengabdian masyarakat ini bertujuan untuk mengimplementasikan dan mengevaluasi strategi zero waste melalui pemberdayaan kelompok PKK Ecomitra di Desa Wage, Sidoarjo, dengan memanfaatkan teknologi tepat guna berupa dekomposer dua sisi (Dedisi) dan lubang biopori untuk pengolahan sampah organik rumah tangga. Program dilaksanakan menggunakan pendekatan Participatory Action Research (PAR) yang melibatkan mitra secara aktif dalam tahap perencanaan, sosialisasi, pelatihan, penerapan teknologi, serta evaluasi. Evaluasi dilakukan melalui metode pretest dan posttest terhadap 15 indikator pengetahuan dan sikap peserta. Hasil menunjukkan peningkatan signifikan dalam pemahaman proses fermentasi, keterampilan pemilahan sampah, kesadaran terhadap konsep zero waste, serta pemanfaatan biopori. Tingkat capaian program secara keseluruhan melebihi 80 persen dari target yang ditetapkan. Hasil ini menunjukkan bahwa strategi zero waste berbasis keputusan kolektif masyarakat dan penerapan teknologi sederhana efektif dalam meningkatkan kapasitas dan perilaku pengelolaan sampah rumah tangga serta mendukung pencapaian SDGs 12 dan SDGs 13.

Kata Kunci: Dedisi; pemberdayaan masyarakat; PKK Ecomitra; zero waste

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INTRODUCTION

Household waste management remains a major environmental issue in Indonesia, particularly in densely populated residential areas. The increasing volume of household waste, which is dominated by organic materials, poses a serious challenge due to limited waste processing capacity and low public awareness of sustainable waste management practices (Ferronato & Torretta, 2019; Juanto et al., 2025; Juwono & Diyanah, 2021; Rifai, 2025). Recent studies have demonstrated that improper household waste management significantly contributes to environmental pollution, health risks, and the increasing burden on landfills (Putri & Khalawi, 2021; Shabihah et al., 2024; Wahyuni et al., 2023). One approach widely promoted to address this issue is the zero-waste concept. Zero waste emphasizes waste reduction at the source through segregation, reuse, recycling, and organic waste processing, aiming to minimize waste sent to landfills (Mulyana et al., 2020). Empirical evidence from community-based studies shows that household-level zero-waste practices can substantially reduce organic waste volumes while producing value-added products such as compost, eco-enzymes, and organic fertilizers (Firdausi, 2025; Kusumaningrum et al., 2023). However, several studies highlight that the success of zero-waste initiatives depends more on sustained behavioral change and community commitment than on technological interventions alone (Al Fira et al., 2022; Firdani et al., 2023).

Community-based waste management has therefore been recognized as a critical determinant of sustainable environmental practices. Active participation, capacity building, and collective responsibility are essential to ensure that waste management programs are consistently implemented in daily household activities. Women's community organizations, such as the Family Welfare Movement (*Pemberdayaan dan Kesejahteraan Keluarga*/PKK), play a strategic role in household waste management due to their central involvement in domestic decision-making and community coordination (Ngafiyah et al., 2024). Participatory approaches, particularly Participatory Action Research (PAR), have increasingly been applied in community service programs to strengthen community ownership and long-term impact. PAR positions community members not merely as beneficiaries but as active contributors in planning, implementation, and evaluation processes. Previous research indicates that participatory approaches are more effective than top-down intervention models at fostering long-term behavioral change (Syafitri & Afriani, 2024; Wahyuni et al., 2023; Yulianto et al., 2024). Despite the growing number of community-based waste management initiatives, many programs still focus primarily on technical solutions and short-term outcomes.

Limited attention has been given to collective community decision-making as a strategic foundation for sustaining zero-waste practices. Addressing this gap, the present community service program implements a zero-waste strategy by empowering PKK Ecomitra in Wage Village, Sidoarjo, through the integration of appropriate technologies, namely Dekomposer Dua Sisi (Dedisi) and biopore systems, within a participatory framework. The theoretical session focused on fundamental concepts in organic waste treatment, household-based waste management, and strategies to strengthen community capacity (Shaibur et al., 2025). The objective of this program is to implement and evaluate a collectively agreed zero-waste strategy that enhances household waste management knowledge, technical skills, and community commitment. Specifically, this article aims to 1) document the implementation of a participatory zero-waste program; 2) evaluate improvements in community knowledge and practices related to organic waste management; and 3) analyze how collective community decision-making contributes to the sustainability of household waste management initiatives aligned with the Sustainable Development Goals (SDGs).

Literature Review

Household Waste Management

Household waste management is a critical environmental issue in developing countries, particularly in densely populated urban and peri-urban areas. Household waste is commonly defined as solid waste generated by daily domestic activities, with organic waste accounting for the largest proportion (Awasthi et al., 2021). Recent studies report that more than half of municipal solid waste in Indonesia originates from households, with biodegradable

materials accounting for the majority and requiring proper management to prevent environmental pollution and health risks (Restanti et al., 2019; Shabihah et al., 2024). Key indicators of effective household waste management include waste segregation behavior, reduced waste volume, community participation, and the use of appropriate treatment technologies (Zhang et al., 2015).

Zero-Waste Strategy

The zero-waste concept refers to a systematic approach that prioritizes waste reduction at the source, reuse, recycling, and recovery to minimize waste sent to landfills (Ogiemwonyi, 2024). Zero waste is not merely a technical approach, but a behavioral and systemic framework that integrates environmental awareness, community participation, and sustainable consumption patterns (Zaman, 2015). At the household and community levels, zero-waste strategies have been shown to significantly reduce organic waste generation while producing value-added outputs such as compost, eco-enzymes, and organic fertilizers (Pisriwati et al., 2025; Sugiyanto et al., 2024; Syafitri & Afriani, 2024). Indicators commonly used to assess zero-waste implementation include knowledge of waste segregation, consistency in waste-sorting practices, reduction in waste volume, and adoption of reuse and recycling behaviors (See: <https://www.unep.org/resources/annual-report-2025>).

Community-Based Waste Management and Women's Groups

Community-based waste management emphasizes collective responsibility, local participation, and empowerment as essential elements of sustainability. Previous research highlights that waste management programs are more effective when communities are actively involved in decision-making and implementation processes (Al Fira et al., 2022; Harnita, 2025). Women's community organizations, such as the PKK, play a strategic role in household waste management due to their central involvement in domestic activities and community coordination. Studies indicate that empowering women's groups contributes to higher program sustainability, improved waste segregation behavior, and stronger social commitment to environmental practices (Wahyuni et al., 2023).

Appropriate Technology and Sustainable Development Goals

Appropriate technology plays a crucial role in community-based waste management by offering simple, low-cost, and locally adaptable solutions. In this program, two core technologies were applied: a household decomposer (Dedisi) and biopore infiltration holes. Dedisi functions as an aerobic organic waste processing system that accelerates the decomposition of kitchen waste through microbial activity, resulting in compost that can be reused to improve soil fertility. Previous studies have shown that household-scale decomposers effectively reduce organic waste volume while increasing community participation in waste segregation (Restanti et al., 2019). Biopore infiltration holes complement this process by enhancing soil water infiltration and supporting in situ organic matter decomposition. By filling biopore holes with organic waste, microbial and soil fauna activity is stimulated, improving soil structure and reducing surface runoff and flooding risks. Biopore systems have been widely recognized as an environmentally friendly technology for urban and semi-urban waste and water management. When implemented through participatory approaches and community education, the integration of Dedisi and biopore systems contributes directly to Sustainable Development Goals, particularly SDG 12 (Responsible Consumption and Production) through waste reduction and resource recovery, and SDG 13 (Climate Action) by reducing methane emissions from unmanaged organic waste (See: <https://www.unep.org/resources/annual-report-2025>).

METHODS

This community service program employed a Participatory Action Research (PAR) approach. PAR is a methodological approach that integrates research, action, and reflection through the active involvement of community members. PAR positions participants as co-researchers who contribute to problem identification, action planning, implementation, and evaluation. It was selected because it emphasizes active community involvement in identifying problems, planning actions, implementing solutions, and evaluating outcomes collaboratively. This approach positions community members not merely as beneficiaries but as active participants and co-decision-makers throughout the program cycle, thereby strengthening the intervention's ownership and sustainability. The program was conducted at the PKK Ecomitra Residents' Meeting Hall in Wage Village, Sidoarjo Regency, from July to September 2025, encompassing coordination, counseling, training, implementation, and evaluation. A total of 40 PKK members participated in the activities, with an active participation rate exceeding 80%. Through this participatory method, the program is expected to contribute to the formation of a sustainable household waste management culture based on collective community decision-making.

The activity began with a counseling stage aimed at increasing PKK Ecomitra women in Wage Village's understanding and awareness of the urgency of household waste management and of implementing a zero-waste strategy. PKK Ecomitra is a community-based women's group under the PKK organization that actively participates in household management, environmental activities, and local economic empowerment at the village level. As key actors in the daily generation and management of domestic waste, PKK Ecomitra members play a strategic role in promoting sustainable waste practices within households and the wider community. Counseling was conducted through interactive presentations and group discussions facilitated by the service team from Airlangga University. The materials covered the basic principles of zero waste, environmental and health impacts of household waste, the benefits of applying appropriate technologies such as Dedisi and biopore infiltration holes, and their relevance to the SDGs.

The next stage involved intensive training, which was divided into theoretical and practical sessions. The practical session emphasized hands-on application, including organic waste segregation, preparation, and utilization of Dedisi units, fermentation processes for organic waste decomposition, and the construction of biopore holes. This hands-on approach was designed to enhance technical skills and encourage participants to apply the practices independently in their respective households. In this program, success was conceptually defined as an improvement in participants' knowledge, attitudes, and readiness to apply household-based zero-waste practices. Specifically, the program was considered successful if it achieved the following outcomes: 1) increased understanding of zero-waste principles and organic waste processing mechanisms; 2) improved technical skills in waste sorting, fermentation using Dedisi, and utilization of biopore infiltration holes; and 3) strengthened awareness and commitment toward sustainable household waste management practices. These conceptual indicators of success were operationalized through a set of 15 measurement items used in pretest and posttest instruments. The items represented key dimensions of knowledge, attitudes, and self-reported practical readiness related to zero-waste implementation at the household level.

Program effectiveness was assessed by comparing pretest and posttest scores, with success indicated by a positive increase in mean scores across the majority of measurement items and an overall achievement level exceeding 80% of the targeted outcomes. These indicators also served as a basis for formulating recommendations to support the program's sustainability and continuity. Data collection was conducted using a mixed-method approach. Quantitative data were obtained through pretest and posttest questionnaires designed to measure changes in participants' knowledge and attitudes across 15 measurement items, using a five-point Likert scale. Qualitative data were collected through participatory observation during activities and limited semi-structured interviews with PKK members to capture perceptions, experiences, and feedback regarding program implementation. The combination of quantitative and qualitative techniques is consistent with PAR principles, allowing both measurable outcomes and contextual understanding to be captured. Data analysis used a comparative descriptive approach, comparing pretest and posttest

results to identify changes in knowledge and attitudes. Percentage improvements were calculated to evaluate program effectiveness and to identify indicators showing the most significant change. The analysis results were then used to assess program achievements, identify supporting and inhibiting factors, and formulate recommendations for future development.

RESULTS AND DISCUSSION

The zero-waste strategy is a sustainable approach that emphasizes reducing household waste volume, sorting at the source, and reusing waste to add value. In community service activities in the PKK Ecomitra Wage Village community, this strategy was chosen to address the high volume of organic waste that is not being utilized to its full potential. PKK Ecomitra, as a program partner, made a collective decision to adopt appropriate technologies, including Dedisi and biopore holes. This decision marks a paradigm shift in society, transitioning from waste disposal to household waste management as a productive resource that supports family food security and fosters a new culture that prioritizes environmental care. The program's implementation consists of two main stages: counseling and the application of technology practices. In the counseling stage, participants received materials on the basic concept of zero waste, the environmental impact of household waste, and an introduction to Dedisi and biopore technology. Furthermore, the practical stage focuses on direct application, including sorting organic waste, fermenting with Dedisi, and digging biopore holes to accelerate decomposition and increase groundwater permeability (Haryono et al., 2023). Documentation of activities was produced in the form of educational videos, leaflets, and X-banners that function as a continuous learning medium for the community, especially the PKK Ecomitra Wage Village community.



Figure 1. Community Service Activities at PKK Ecomitra Wage Village Sidoarjo
Source: Author's Documentation (2025)

Before the program was implemented, organic waste was commonly disposed of without structured segregation or processing. Although participants recognized the importance of environmental care, technical knowledge of fermentation processes and the operational application of decomposer technology remained low. This condition reflects what environmental behavior studies describe as the “*knowledge–action gap*,” where awareness does not automatically translate into consistent pro-environmental practice (Ogiemwonyi, 2024; Zhang et al., 2015). The participatory discussion format shown in **Figure 1** was essential because it positioned community members as active decision-makers rather than passive recipients. In accordance with Participatory Action Research (PAR) principles, collective agreement to adopt Dedisi and biopore systems strengthened ownership and increased the likelihood of sustainable behavioral change (Ishaq et al., 2025).

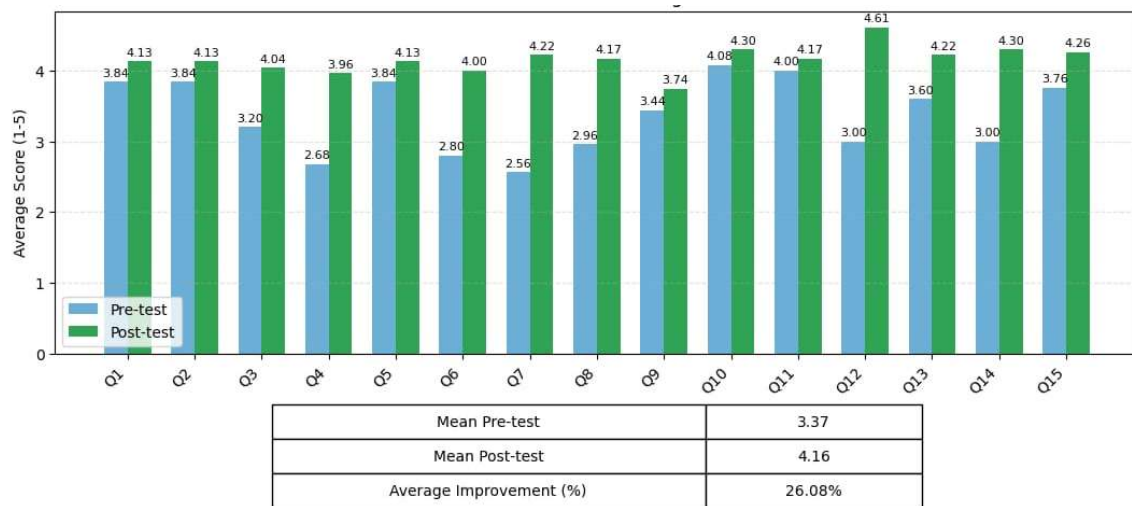


Figure 2. Pretest and Post-test Scores of Community Service Activities
Source: Author's Documentation (2025)

To evaluate program effectiveness, pretest and posttest assessments were conducted using 15 measurement items representing three conceptual dimensions: knowledge, technical skills, and readiness for implementation (Andito et al., 2024; Marzuki et al., 2025). As shown in **Figure 2**, posttest scores were consistently higher than pretest scores across all measurement items. The mean score for understanding the fermentation process increased from 2.56 to 4.22 (+64.84%). Waste sorting skills improved from 3.00 to 4.61 (+53.67%), and utilization of biopore holes increased from 3.00 to 4.30 (+43.33%). These results demonstrate that the program successfully improved not only cognitive understanding but also technical competence. The substantial increases in applied skills indicate that hands-on participatory practice is more effective than awareness-based counseling alone. Behavioral change theory suggests that experiential engagement enhances internalization and reduces the gap between knowledge and action (Syafitri & Afriani, 2024; Zhang et al., 2015).

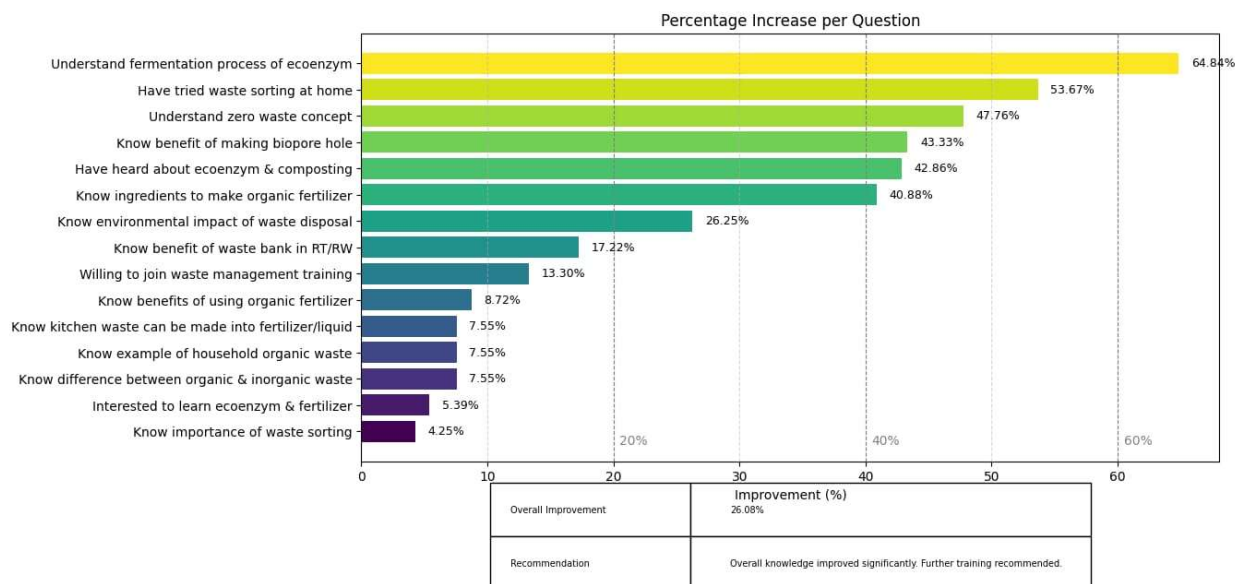


Figure 3. Percentage Increase in Score per Question
Source: Author's Documentation (2025)

Figure 3 presents the percentage increase for each measurement item, providing deeper insight into the areas of greatest transformation. The highest growth occurred in understanding eco-enzyme fermentation (+64.84%) and in practical waste-sorting experience (+53.67%). These findings suggest that technical gaps were the most significant initial weakness and were effectively addressed through direct practice. In contrast, indicators such as “*importance of sorting waste*” (+4.25%) and “*interest in learning eco-enzyme and fertilizers*” (+5.39%) showed smaller increases. This indicates that baseline awareness was already relatively high, resulting in a ceiling effect. Therefore, the limited percentage increase does not indicate failure but rather confirms that the intervention primarily strengthened areas where technical deficits previously existed. Overall program achievement exceeded 80% of predefined targets, confirming that the conceptual indicators of knowledge enhancement, technical skill improvement, and readiness for zero-waste implementation were successfully achieved.

Discussion

Beyond numerical improvements, observable changes occurred in community practices after program implementation. Participants began actively utilizing Dedisi units to process household organic waste. Fermentation practices were initiated independently, and biopore holes were constructed and filled with organic waste as part of routine management. This behavioral transformation indicates a shift from a disposal-oriented mindset to a resource-oriented approach. Organic waste was no longer perceived as a burden but as a productive input for soil fertility and household food security. Such transformation aligns with findings that emphasize community ownership and collective commitment as key determinants of sustainable environmental programs (Al Fira et al., 2022). Initially, there was a clear discrepancy between the ideal condition of systematic household waste management and the actual practice in PKK Ecomitra. Through participatory empowerment and integration of simple, appropriate technologies, this gap was significantly reduced. In the context of waste management, PAR has been shown to enhance community ownership, strengthen technical skills, and promote long-term behavioral change compared to top-down intervention models (Al Ramadhani et al., 2025; Syafitri & Afriani, 2024). The before-and-after comparison confirms that the program contributed to measurable knowledge gains, strengthened technical capacity, and fostered real behavioral change (Andito et al., 2024; Marzuki et al., 2025). From a sustainability perspective, the integration of Dedisi and biopore systems supports SDG 12 (Responsible Consumption and Production) by reducing organic waste disposal and enhancing resource recovery, as well as SDG 13 (Climate Action) through the reduction of methane emissions from unmanaged organic waste (Restanti et al., 2019; Wang et al., 2025). Thus, the zero-waste strategy implemented in PKK Ecomitra Wage Village demonstrates that community empowerment combined with appropriate technology can effectively transform household waste management practices from awareness-based concern into structured, sustainable action.

CONCLUSION

The community service program, based on the zero-waste strategy, implemented with PKK Ecomitra in Wage Village, has proven effective in improving community knowledge, skills, and attitudes in managing household waste. The community's collective decision to adopt appropriate technologies, namely Dedisi (a double-sided decomposer) and biopore pits, has encouraged a behavioral shift from merely disposing of waste to managing organic waste as a productive resource. The results of the pretest and posttest evaluations demonstrated significant improvements, particularly in technical understanding of eco-enzyme fermentation, waste-sorting skills, awareness of the zero-waste concept, and the use of biopore holes. These findings indicate that participatory methods emphasizing hands-on practice can effectively strengthen sustainable behavior change within the community. In addition to generating tangible outputs in the form of applied technology, early organic products, and educational media, this program also expanded its impact through online publications and digital dissemination. Therefore, the zero-waste strategy

implemented by PKK Ecomitra Wage not only contributes to sustainable development by supporting the achievement of SDGs 12 and SDGs 13, but also strengthens Airlangga University's contribution to community service performance indicators. Future research and community service initiatives may further examine the long-term sustainability of household-based zero-waste practices, including integrating community waste entrepreneurship and digital monitoring systems to enhance environmental impact and strengthen community participation in sustainable waste management.

AUTHOR'S NOTE

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