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Community Empowerment through Eco-Enzyme Training for Sustainable Household Organic Waste Management

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Abstract– The ECOLORA (Eco enzyme for Environmentally Friendly Household Waste Processing) program aimed to improve the knowledge and skills of residents in RW 02, Nginden Jangkungan Village, Surabaya, in managing household organic waste. The program involved 20 participants consisting of housewives and micro, small, and medium enterprise (MSME) actors. The implementation methods included educational sessions, demonstrations and hands-on eco enzyme production, discussions, and evaluation using pre-test and post-test instruments. The results showed increased participant knowledge across six assessment indicators. The proportion of correct responses increased from 25–65% in the pre-test to 100% across all indicators in the post-test, with an average increase of 49.17 percentage points. The largest improvement was observed in understanding the fermentation process, which increased by 75 percentage points. The program demonstrates that participatory training can improve community knowledge of household organic waste management.

Keywords: eco enzyme; organic waste; community empowerment; waste management; household

1. INTRODUCTION

Waste management is a significant environmental challenge facing many nations, driven by population growth, urbanization, and shifting consumption patterns. Rising waste volumes when not matched by adequate management systems can lead to environmental pollution, compromised public health, and increased greenhouse gas emissions resulting from the accumulation of organic waste in landfills (Bilafiqri et al., 2025). Research indicates that high levels of organic waste generation have placed an immense burden on landfill capacity, necessitating waste reduction strategies that begin at the source through community empowerment (Djarot et al., 2024; Jannah et al., 2022).

In Indonesia, the household sector is the largest contributor to national waste generation, accounting for 39.75% of the total, with food waste making up the largest share at 41.69% (Bilafiqri et al., 2025). Furthermore, approximately 75% of the generated waste consists of organic kitchen waste, much of which remains underutilized (Wibowo et al., 2021). Low public awareness regarding waste sorting and processing means that the majority of this waste ends up in landfills, is burned, or is discharged into waterways, thereby degrading environmental quality (Nafilah et al., 2024; Rendana et al., 2025). These conditions highlight the need to strengthen household level waste management by enhancing community knowledge and skills.

As Indonesia's second-largest metropolitan area, Surabaya also faces challenges in waste management. According to the city's 2025–2026 Regional Policy and Strategy for Waste Management, annual waste generation stands at 660,946.82 tons, whereas waste reduction efforts have only achieved 49,090.68 tons approximately 7.43% of the total waste generated. On the other hand, the composition of waste in Surabaya is dominated by food waste (54%),

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with the household sector being the largest contributor, accounting for 85.2% of total waste generation (Patoppoi, 2023; Surabaya, 2025). This situation indicates that the success of waste management in Surabaya depends not only on the provision of infrastructure by the government but also requires active community involvement in sorting and processing waste at the source. Supriyanto et al., (2023) further explain that a significant portion of organic waste in Surabaya still ends up in landfills because it is not yet optimally utilized at the household level.

RW 02 in Nginden Jangkungan Urban Village, Sukolilo District, is one area facing this issue. Initial observations and coordination with RW administrators revealed that household organic waste such as fruit peels and vegetable scraps is still discarded alongside other waste without any sorting or processing. Consequently, this organic waste fails to generate added value for the community and contributes to an increased volume of waste sent to landfills. This situation aligns with findings by Muarief et al., (2023) dan Wasito et al., (2023), which indicate that many communities still rely on conventional waste management practices, such as burning or direct disposal, rather than reusing materials. Given these circumstances, the community partners require a solution that is simple, easy to implement, and manageable on an individual basis to reduce household organic waste generation.

One appropriate technology that can be implemented is "eco-enzyme" a liquid produced by fermenting organic waste (such as fruit peels or vegetable scraps) with palm sugar or molasses and water in a 1:3:10 ratio over a period of approximately 90 days (Sakinah et al., 2024). Eco-enzyme offers various benefits, serving as a liquid organic fertilizer, natural cleaning agent, pesticide, and eco-friendly antimicrobial agent (Mahfur et al., 2025). Implementing this technology is relatively straightforward, as it utilizes organic waste readily available in households and requires no complex equipment. Therefore, eco-enzyme presents a viable alternative for reducing organic waste generation while simultaneously enhancing the utility of household waste.

Various community service initiatives have demonstrated that eco-enzyme training effectively improves community knowledge, skills, and awareness regarding organic waste management. Such activities have shown that eco-enzyme training enhances participants' understanding and skills in processing organic waste and converting it into useful products (Jannah et al., 2022; Siregar et al., 2025; Widyaningsih et al., 2024). However, most such activities have previously been conducted within school settings, farmer groups, Islamic boarding schools, or PKK (Family Welfare Empowerment) groups. In contrast, this community service initiative implements the ECOLORA Program (Eco-Enzyme for Eco-Friendly Household Waste Processing) in an urban neighborhood (RW) setting. It employs an integrated approach combining awareness-raising, training, hands-on practice, and participatory discussions, alongside pre- and post-test evaluations, to enhance the community's capacity to manage organic waste independently.

Addressing these issues, the Community Service (KKN) team from Universitas Pembangunan Nasional "Veteran" East Java implemented the ECOLORA Program in RW 02, Nginden Jangkungan Urban Village, Surabaya City. This initiative aims to enable the community to reduce the volume of organic waste discarded into the environment, utilize eco-enzymes in daily life, and strengthen community participation in creating a clean, healthy, and sustainable environment.

2. IMPLEMENTATION METHOD

The community service activity was conducted on June 27, 2026, at the residence of the Head of RW 02 in Nginden Jangkungan Urban Village, Sukolilo District, Surabaya City. The partners for this activity were the residents of RW 02, comprising housewives and Micro, Small, and Medium Enterprise (MSME) operators. A total of 20 participants from various RTs (neighborhood units) took part in the entire series of activities. The program utilized a participatory approach that positioned the community as the primary subject of the learning process through active involvement at every stage. This approach was selected for its ability to enhance community understanding and skills by combining awareness-raising, demonstrations, hands-on practice, and discussions an approach known as "learning by

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doing" consistent with methods used in various Eco-enzyme training programs (Siregar et al., 2025; Wibowo et al., 2021).

The activity began with a preparatory phase involving coordination with the RW Head and local administrators to schedule the event, select the venue, and identify the partners' needs regarding household organic waste management. The subsequent phase involved an educational session on waste management based on the 3R principles (Reduce, Reuse, Recycle), covering the basic concepts, benefits, and production procedures of Eco-enzyme. Following the presentation, participants engaged in demonstrations and hands-on practice in making Eco-enzyme using household organic waste (fruit peels and vegetable scraps), palm sugar or molasses, and water, mixed in a 1:3:10 ratio. During the practical session, participants received guidance on every step from ingredient selection, mixing, and the fermentation process to storage techniques enabling them to produce Eco-enzyme independently.

These stages of awareness-raising, demonstration, and hands-on practice followed Eco-enzyme training methodologies successfully implemented in various prior community service initiatives (Djarot et al., 2024; Jannah et al., 2022; Wasito et al., 2023). The activity concluded with a Focus Group Discussion (FGD), providing a platform for participants to discuss household waste management challenges, share experiences, and formulate opportunities for implementing Eco-enzyme practices within the RW neighborhood. The Focus Group Discussion (FGD) approach was selected to enhance participant participation and interaction within the community empowerment process (Widyaningsih et al., 2024).

Achievement of activity targets was measured using pre-test and post-test instruments administered before and after the training. Evaluation focused on six knowledge indicators: understanding the basic concepts of eco-enzyme, the raw materials used, the general benefits of eco-enzyme, its environmental benefits, the utilization of fermentation residues, and the fermentation process itself. Additionally, observations conducted during the practical sessions were used to assess participants' skills in executing each stage of eco-enzyme production. A one-group pre-test and post-test design was chosen to measure changes in participant knowledge following the training intervention, a method commonly applied in various eco-enzyme educational activities (Rendana et al., 2025; Sudarti et al., 2025). Evaluation results were analyzed descriptively by comparing pre-test and post-test scores to determine the extent of knowledge improvement, while observational data served to assess participants' practical skills. To evaluate program sustainability, participants were encouraged to independently produce eco-enzyme at home and utilize the fermentation products in their daily lives, thereby fostering sustainable organic waste management (Fredicia et al., 2025).

3. RESULTS AND DISCUSSION

3.1 Implementation of Eco-enzyme Training Activities

The primary issue facing the residents of RW 02, Nginden Jangkungan Urban Village, Sukolilo District, Surabaya City, is the suboptimal management of household organic waste. Initial observations and coordination with the RW Chairperson revealed that organic waste such as fruit peels and vegetable scraps was being discarded alongside other refuse without undergoing any sorting or utilization processes. This situation meant that the organic waste failed to provide added value to the community and contributed to an increased volume of waste sent to the final disposal site (TPA). These issues served as the basis for implementing the ECOLORA Program (Eco-enzyme for Eco-friendly Household Waste Processing), an initiative aimed at enhancing community capacity in managing household organic waste.

The program began with an outreach session covering waste management based on the 3R principles (Reduce, Reuse, Recycle), the characteristics of household organic waste, the basic concepts of eco-enzymes, their benefits, and the production process. During this session, participants shared the various challenges they faced in managing household waste. Most participants admitted they were unaware that organic waste could be processed into useful products, explaining why they had previously discarded it along with other trash. These findings indicate that public awareness and knowledge regarding organic waste management

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remain relatively low. This aligns with the findings of Jannah et al., (2022) , who noted that the public generally does not yet grasp the potential of organic waste; thus, eco-enzyme training is essential to foster greater awareness regarding household waste management.

Figure 1. Presentation of Material

Following the presentation, the activity proceeded with a demonstration and hands-on practice of making eco-enzymes using organic waste (fruit peels and vegetable scraps), palm sugar or molasses, and water, mixed in a 1:3:10 ratio. During the practical session, participants received guidance on every step of the process, from ingredient selection and mixing to fermentation and storage techniques. A "learning-by-doing" approach was adopted to ensure participants gained direct experience, enabling them to both understand the concepts and independently produce eco-enzymes. The method proved effective in boosting participant engagement, evidenced by the enthusiasm shown during both the practical sessions and discussions regarding suitable waste types, fermentation duration, and the utilization of the final product. These findings align with research by Siregar et al., (2025) which demonstrated that demonstration-based and hands-on learning significantly enhances participants' technical skills. Putri et al., (2026) also noted that demonstration methods make it easier for participants to grasp the Eco-enzyme production process compared to purely theoretical instruction.

Figure 2. Eco-enzyme production practice

Beyond enhancing technical skills, the discussions held during the training revealed a shift in the community's perspective on household organic waste. Prior to the activity, organic waste was viewed merely as refuse to be discarded immediately. After receiving instruction and engaging in hands-on practice, participants began to understand that organic waste could be transformed into liquid organic fertilizer, natural cleaning agents, compost activators, or

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natural pesticides. This shift in perception indicates that the training not only increased knowledge but also began to foster community awareness regarding the importance of household-level waste management. These results are consistent with the findings of Mahfur et al., (2025), who stated that Eco-enzyme training can transform public perception, shifting the view of waste from something valueless to a resource offering both economic and environmental benefits.

3.2 Increase in Participant Knowledge Based on Pre-test and Post-test Results

Training effectiveness was evaluated using pre-test and post-test instruments covering six knowledge indicators: basic eco-enzyme concepts, raw materials, eco-enzyme benefits, environmental benefits, the fermentation process, and the utilization of fermentation residue. The evaluation involved 20 participants to assess changes in knowledge levels following the completion of the entire activity series.

Table 1. Pre-test and Post-test Results Based on Knowledge Indicators

Indicator	Pre-test Correct (%)	Post-test Correct (%)	Increase
Knowledge of Eco-enzyme	40	100	+60%
Knowledge of Eco-enzyme ingredients	60	100	+40%
Benefits of Eco-enzyme	65	100	+35%
Environmental benefits of Eco-enzyme	55	100	+45%
Eco-enzyme fermentation process	25	100	+75%
Benefits of Eco-enzyme residue	60	100	+40%

Source: Data processed by the author

Based on Table 1, all indicators showed improvement following the training. Prior to the activity, participants' knowledge levels ranged from 25% to 65%, whereas after the training, all participants were able to correctly answer questions regarding all measured indicators. These results demonstrate that the training method combining information sessions, demonstrations, hands-on practice, and discussions was effective in enhancing participants knowledge regarding household organic waste management through eco-enzymes.

Improvements were observed in the understanding of basic eco-enzyme concepts and the raw materials required for production. After the training, all participants could define eco-enzymes and correctly identify their constituent materials, including the use of organic waste, palm sugar or molasses, and water in the appropriate ratios. These findings indicate that demonstrations and hands-on practice facilitated the participants' understanding of technical material and the importance of precise ingredient composition during the fermentation process (Putri et al., 2026; Rukmini & Herawati, 2023).

Participants' understanding also improved regarding the benefits of eco-enzyme whether as liquid organic fertilizer, a natural cleaning agent, a compost activator, or an organic pesticide. Furthermore, participants grasped that the fermentation residue could still be utilized as organic fertilizer, ensuring that the entire fermentation output held practical value. These findings indicate that the training successfully broadened participants' perspectives on the comprehensive utilization of organic waste (Lubis et al., 2025; Pribadi et al., 2022; Zultaqawa et al., 2023).

The most significant improvement occurred in the fermentation process indicator, rising from 25% to 100%. Prior to the training, most participants lacked understanding regarding fermentation duration, ingredient ratios, and eco-enzyme storage techniques. Following the demonstrations and hands-on practice, all participants were able to correctly explain the stages of the fermentation process. These results indicate that a learning-by-doing approach is more effective in enhancing participants' understanding of technical concepts than relying solely on theoretical instruction. (Hidayat et al., 2023; Siregar et al., 2025).

Overall, improvements across all indicators demonstrate that the training successfully addressed the partner's primary issue: the community's limited knowledge regarding household organic waste management. Beyond enhancing cognitive understanding, the activity fostered a shift in community perception, viewing organic waste as a resource that can be utilized independently. These findings align with previous community service initiatives

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showing that participatory eco-enzyme training effectively boosts community knowledge, skills, and readiness to manage organic waste sustainably (Hidayat et al., 2023; Mahfur et al., 2025; Rendana et al., 2025; Siregar et al., 2025).

4. CONCLUSION

The ECOLORA program (Eco-enzyme for Eco-friendly Household Waste Processing) successfully enhanced the capacity of the RW 02 community in Nginden Jangkungan Urban Village to manage household organic waste through awareness-raising, training, hands-on practice, and participatory discussions. The program addressed the partners' challenges regarding the community's limited knowledge and skills in transforming organic waste into useful products. Evaluation results demonstrated improved knowledge across all measured indicators, evidenced by the rise in the percentage of correct answers from a range of 25–65% in the pre-test to 100% in the post-test. Beyond increasing knowledge, the initiative fostered a shift in the community's perspective on organic waste transforming it from mere refuse into a valuable resource for producing eco-enzymes usable as liquid organic fertilizer, natural cleaning agents, and eco-friendly pesticides.

This program holds the potential to reduce household organic waste generation while strengthening community participation in sustainable environmental management. To ensure the program's lasting impact, continued guidance during the fermentation process is required, alongside the formation of environmental groups or cadres at the RW level to drive the adoption and dissemination of eco-enzyme technology to the wider community.

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