



Empowerment of Environmental Communities in Organic Waste Management through Eco-Enzyme Production Training in Malang City

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ABSTRACT

Waste management remains one of the most pressing challenges for major cities in Indonesia, including Malang City. In 2023, Malang generated approximately 778.34 tons of waste per day, dominated by food waste (54.39%), garden waste (13.60%), and plastic (13.66%). This situation indicates the predominance of organic waste that requires sustainable handling directly from its source. The main problem faced by environmental community partners is the lack of knowledge and practical skills in managing organic waste effectively. To address this issue, a community engagement program was conducted to enhance awareness and capacity in producing eco-enzyme, a fermented liquid derived from organic waste that can be utilized as a natural cleaner and fertilizer. The program was implemented through three stages: socialization on the importance of waste management, hands-on eco-enzyme production training, and evaluation through an online survey completed by all participants immediately after the training. The training involved 25 participants from 12 environmental communities in Malang City. The results showed that 84% of participants gained a better understanding of eco-enzyme production and expressed readiness to apply it within their communities. This activity successfully fostered environmental awareness, promoted waste reduction at the community level, and supported the realization of a cleaner, healthier, and more sustainable urban environment.

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A. INTRODUCTION

Malang City, one of the rapidly developing urban centers in East Java, generates approximately 778.34 tons of waste per day, with food waste (54.39%), garden waste (13.60%), and plastic (13.66%) as the largest components (Pemerintah Kota Malang, 2023). The dominance of organic waste shows that a large share of the city's waste burden could be reduced at its source, namely households and communities, instead of relying mainly on



collection and disposal at the Supiturang Final Processing Site (TPA), whose capacity is increasingly limited (Radar Malang, 2023).

Previous research emphasizes that active community participation is essential for sustainable waste reduction and local environmental improvement (Artiningsih & Hadi, 2012; Darwati & Anggraeni, 2012; Sari et al., 2020). Studies on community-based solid waste management show that when local actors are empowered with knowledge and simple technologies, waste can be transformed into a valuable resource (Sinthumule & Mkumbuzi, 2019; Sibagariang et al., 2023).

One innovation that supports this approach is the **eco-enzyme**, a fermented organic liquid made from fruit peels, vegetables, and sugar, which functions as a natural cleaner, fertilizer, and even for wastewater treatment (Prasetyo & Arifin, 2017; Nurfajriah et al., 2021; Janarthanan et al., 2020; Sarminingsih et al., 2023).

However, awareness and technical skills related to eco-enzyme production remain limited among environmental communities in Malang. This condition reflects a missed opportunity to address the dominance of organic waste through low-cost, environmentally friendly technology. Therefore, this community engagement program was designed to strengthen the capacity of local environmental communities through participatory eco-enzyme training. The program aims to (1) enhance community awareness of sustainable organic waste management, (2) develop technical skills for eco-enzyme production, and (3) encourage collaborative community-based waste reduction practices aligned with the national *Indonesia Bersih 2025* agenda (Peraturan Presiden Nomor 97 Tahun 2017).

B. METHODS

This community engagement program used a participatory training approach that combined socialization, hands-on practice (learning by doing), and post-training evaluation. The activity was carried out by the FISIP Universitas Brawijaya community service team in collaboration with EPYC.ID and the Malang City Environmental Agency (DLH) on Friday, 21 March 2025, starting at 14.00 WIB, at Nutrihub Malang. The target participants were members of environmental communities in Malang City and its surrounding areas. Participants were recruited through an open online registration form distributed via community networks; 29 people registered, and 25 participants representing 12 environmental communities attended the activity. The program was implemented through three stages: preparation, implementation, and evaluation, as described below.

1. Preparation Stage.

The preparation stage included identifying the needs of the partner community, developing the project proposal, coordinating with resource persons and partner organizations, and preparing the training and outreach materials. In addition, a participant mapping process was carried out to determine the target audience and ensure representation from several community groups across Malang City. All necessary tools and materials for the eco-enzyme production practice—such as containers, brown sugar, fruit and vegetable waste, and water—were also prepared in advance to facilitate smooth training sessions. The registration form also recorded each participant's domicile, community of origin, and role in the community, which were used as the basis for participant mapping (Figures 2–4). Practice materials were prepared for each group of participants, consisting of



airtight plastic containers with screw caps, brown sugar (or molasses), fresh fruit and vegetable peels, clean water, a scale, and measuring cups.

2. Implementation Stage.

The implementation consisted of two main sessions. The first session was a **socialization workshop** focusing on the importance of community participation in waste management, featuring a speaker from the Environmental Agency of Malang City (DLH). This session emphasized the role of local communities as key actors in achieving sustainable waste reduction. The second session was a **hands-on training** on eco-enzyme production, guided by a trainer experienced in environmental community practices. During this session, participants learned about the fermentation process, the ratio of ingredients, proper storage, and the potential uses of eco-enzyme for household and community-scale applications. The training adopted a participatory learning approach, encouraging dialogue and peer-to-peer sharing among participants to strengthen their practical understanding.

The eco-enzyme production practice followed a standard procedure using a ratio of 1:3:10, namely one part brown sugar, three parts fresh fruit and vegetable peels, and ten parts water by weight. The steps were: (a) dissolving the brown sugar in water inside the container; (b) adding the chopped fruit and vegetable peels; (c) filling the container to a maximum of about 80% of its volume to leave space for fermentation gas; (d) closing the container tightly and labeling it with the production date; and (e) storing it in a cool, shaded place for three months, opening the lid briefly to release gas during the first weeks of fermentation. After three months, the liquid is filtered and ready for use, while the residue can be reused for the next batch or as compost. Participants carried out these steps directly in groups under the guidance of the trainer and took the resulting containers home to continue the fermentation independently.

3. Evaluation Stage.

The evaluation aimed to assess the effectiveness of the program and the changes in participants' understanding, skills, and intention after the training. Two complementary evaluation methods were used. First, a **quantitative survey** was administered at the end of the activity on 21 March 2025, immediately after the closing session, through an online Google Form (Figure 9) whose link was shared with all attending participants. All 25 participants completed the form (response rate 100%). The questionnaire consisted of closed-ended items rated on a Likert scale covering four aspects: (1) understanding of the eco-enzyme concept and production steps, (2) perceived usefulness and feasibility of eco-enzyme, (3) intention to apply eco-enzyme within their communities, and (4) overall satisfaction with the training, followed by open-ended questions on perceived barriers and suggestions. Second, a **qualitative assessment** was conducted using notes from the question-and-answer discussion, participants' testimonials, and the answers to the open-ended survey questions. Quantitative data were analyzed

descriptively using frequencies and percentages, while qualitative data were grouped thematically (perceived benefits, intention to adopt, and barriers) and used to triangulate the survey results.

C. RESULTS AND DISCUSSION

The community service program was conducted on Friday, 21 March 2025, at Nutrihub Malang (Jl. Besar Ijen No. 19b, Oro-oro Dowo, Malang City, East Java). The main objective of this activity was to strengthen awareness and practical capacity within environmental community groups to manage organic household waste through eco-enzyme production. This approach reflects the shift of waste governance from downstream-disposal orientation toward upstream reduction at source, where behavioral change and community ownership become the primary drivers of sustainability. The results are presented in three parts: participant mapping, implementation of activities, and changes in participants after the activity.



Figure 1. Pamphlet

1.1. Participant Mapping

Based on the participant mapping conducted prior to the activity, the majority of attendees were representatives from environmental community groups operating within Malang City. These groups function as grassroots environmental actors that have been actively engaged in local waste reduction campaigns and community-based environmental education. The distribution of participant domicile is presented in Figure 2.

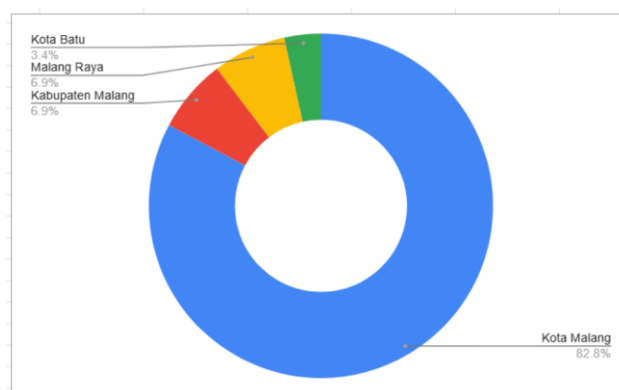


Figure 2. Participant Community Domicile



Each community delegated approximately 1-2 representatives. From a capacity-building perspective, this pattern indicates a knowledge carrier model in which selected delegates are expected to internalize the learning materials and subsequently transfer the knowledge to other members within their respective communities. The proportional distribution of community origins is illustrated in Figure 3.

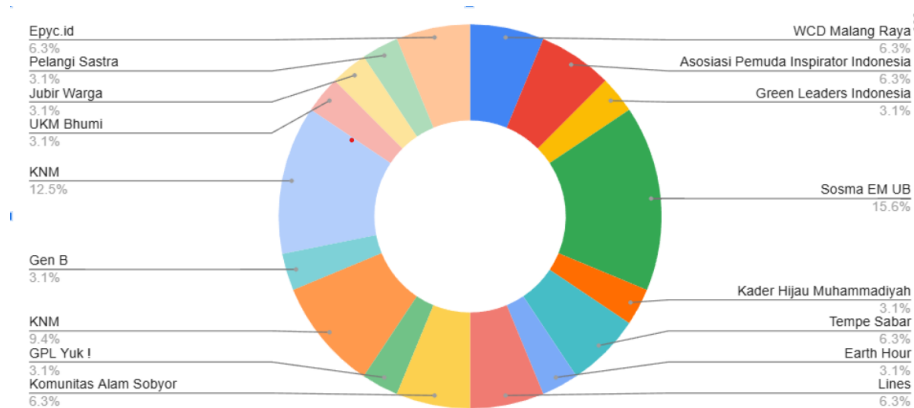


Figure 3. Origin of Participant Communities

Furthermore, the delegates attending the activity held diverse positions within their respective organizations. While most participants were general members or grassroots cadres, a considerable proportion of community leaders and technical advisors were also present. The distribution of participant roles is displayed in Figure 4.

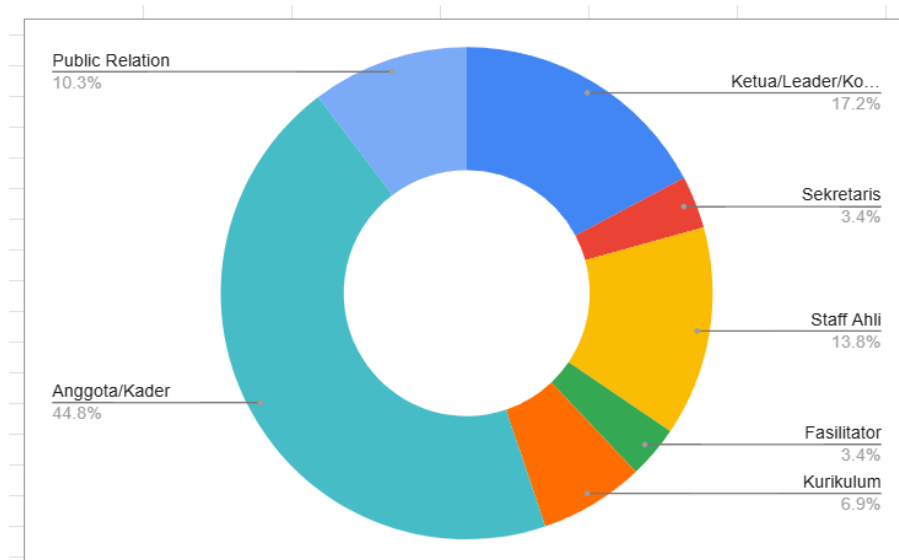


Figure 4. Participant Role Distribution

1.2. Implementation of Activities

The activity began with a socialization session delivered by a representative from the Malang City Environmental Agency (DLH). This session contextualized eco-enzyme within the broader waste management challenges of Malang City, emphasizing the strategic role of community-based initiatives as an upstream intervention capable of reducing the volume of organic waste disposed at the landfill. The discussion also highlighted the importance of monitoring neighborhood waste flows, encouraging participants not only to sort waste but also to take part in local environmental governance.



Figure 5. Policy Briefing Session by the Malang City Environmental Agency (DLH)

After the socialization session, the activity continued with a hands-on eco-enzyme production workshop facilitated by trainers from a local environmental community. Participants were introduced to the basic concept of eco-enzyme, its potential environmental benefits, and the step-by-step production process using household organic waste, sugar, and water. Importantly, the training design adopted a learning by doing approach, where participants were guided to practice the process directly rather than only receiving theoretical explanation. This approach was intended to strengthen procedural understanding and enhance the likelihood of behavioral change.



Figure 6. Hands-on Eco-enzyme Production Workshop

The activity concluded with an open question-and-answer session, where participants actively explored opportunities for collaboration, institutional support, and future program development.



Figure 7. Question and Answer Session

The formal agenda was then closed with a ceremonial appreciation and group documentation session.



Figure 8. Closing Session and Group Photo

1.3. Changes in Participants after the Activity

Changes in participants were assessed immediately after the activity through the post-training survey completed by all 25 participants (Figure 9). Three types of change were identified. First, in terms of knowledge, 84% of participants (21 of 25) stated that they had gained a better understanding of eco-enzyme, including the 1:3:10 ingredient ratio, the three-month fermentation period, and its uses as a natural cleaner and liquid fertilizer. Second, in terms of skills, all participants practiced producing eco-enzyme directly during the workshop, so that each community returned with its own fermentation batch that can serve as a demonstration unit for other members. Third, in terms of attitude and intention, most participants chose “agree” or “strongly agree” on the items related to perceived feasibility and intention to apply eco-enzyme, indicating a shift from merely knowing about eco-enzyme toward readiness to practice it in their communities. Because no pre-test was administered, these changes are based on participants’ self-assessment after the training.

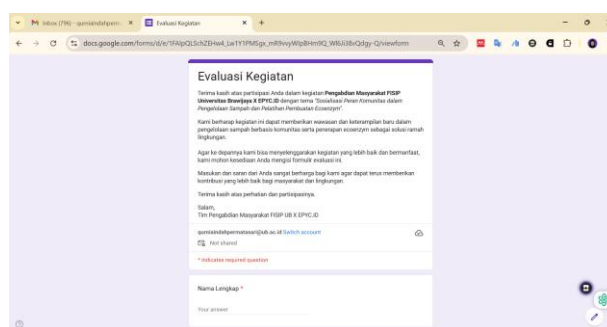


Figure 9. Online Post-Training Evaluation Form

In terms of overall satisfaction, 80% of respondents were satisfied and the remaining 20% were fairly satisfied with the training, while none expressed dissatisfaction (Figure 10). Together with the high proportion of positive responses on the feasibility and intention items, this indicates that participants did not merely judge the workshop as “informative” or “interesting”, but also felt confident to apply eco-enzyme within their own community routines. This suggests that the training helped bridge the common gap between knowledge acquisition and behavioral intention, an important indicator of potential downstream impact at the community level.

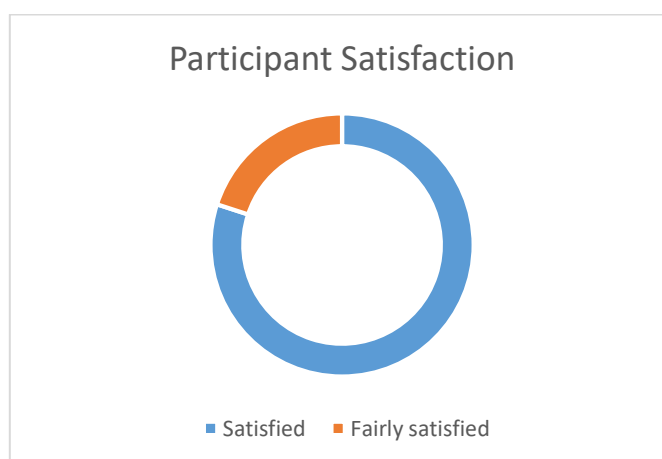


Figure 10. Participant Satisfaction with the Training (n = 25)

In addition to the quantitative results, the qualitative responses during the evaluation provide further triangulation. Several participants explicitly stated that eco-enzyme represents a practical and realistic entry point for reducing household organic waste. One community leader noted that eco-enzyme can be implemented immediately without requiring complex technology or high economic cost. Another participant expressed the expectation that similar capacity-building activities should be scaled up to involve more community groups in Malang City. These statements validate the survey trends and reinforce the interpretation that the workshop has effectively generated both motivation and perceived feasibility for eco-enzyme adoption. The post-training survey responses were further synthesized to capture the key dimensions of learning and adoption intention. The following table summarizes the core findings derived from the participants’ feedback.



Table 1. Summary of Key Survey Findings

No	Aspect Assessed	Summary Result
1	Awareness of eco-enzyme	Most participants reported having basic understanding of eco-enzyme concepts after the training.
2	Intention to adopt eco-enzyme	Participants expressed strong willingness to apply eco-enzyme practices within their community routines.
3	Main barriers identified	Limited advanced technical knowledge and time constraints were mentioned as the main obstacles for wider adoption.

Overall, these patterns confirm that the training did not only transfer basic knowledge, but also successfully stimulated behavioral intention to adopt eco-enzyme practices at the community level. However, the emerging constraints indicate that follow-up activities are still needed, especially in the form of advanced sessions that guide communities through more technical processes and provide continuous mentoring to ensure long-term adoption. It should be noted that the changes reported here were measured immediately after the training and rely on participants' self-assessment. Actual behavioral change, such as the number of communities that continue producing and using eco-enzyme after the three-month fermentation period, will be verified through follow-up monitoring.

D. CONCLUSION

This community engagement program demonstrates that eco-enzyme training is an effective educational intervention to enhance both conceptual understanding and practical skills in organic waste management among local environmental communities. The post-training evaluation completed by all 25 participants showed that 84% reported an improved understanding of eco-enzyme production and 80% were satisfied with the training. The hands-on approach successfully encouraged participants to commit to applying eco-enzyme practices within their respective initiatives, indicating potential contribution to upstream waste reduction at the household level. However, challenges remain in terms of limited coverage and uneven capacity for eco-enzyme production at the community base. Therefore, similar initiatives should be replicated at the village/kelurahan scale and complemented by periodic monitoring to evaluate behavioral change and the sustainability of eco-enzyme adoption over time.

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environmental communities in Malang who actively participated and contributed to the collective learning process throughout this program.

F. AUTHOR CONTRIBUTIONS

Qurnia Indah Permata Sari (QIPS) led the manuscript preparation (original draft), coordinated data collection and documentation, and was directly involved in the activity implementation and results interpretation. Wimmy Haliim (WH) contributed to the design of the survey instrument, participated in activity implementation, and co-interpreted the findings. Deviana Mayasari (DM) supported data documentation, contributed to survey evaluation and instrument review, and participated in manuscript editing. Taufik Akbar (TA) contributed to activity implementation and supported manuscript revision and final editorial improvements.

G. AI USAGE DECLARATION

Parts of this manuscript (including but not limited to language editing, grammar polishing, and structural refinement) were assisted by Artificial Intelligence (AI) tools. All conceptual development, data interpretation, argument building, and final decisions on content were solely determined by the authors. The authors take full responsibility for the scientific accuracy, originality, and integrity of the manuscript.

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