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Innovative Waste Management and Community Education at AKB Restaurant: A Sustainable Approach to Liquid Organic Fertilizer Production

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ABSTRACT

This community engagement initiative aimed to address organic waste management issues at the Angkringan Kampung Belimbing (AKB) restaurant by introducing innovations in liquid organic fertilizer (LOF) production and environmental education. The approach included initial observation, awareness sessions, hands-on LOF training using kitchen waste and Effective Microorganisms 4 (EM4), and evaluation through application on water spinach and shallot plants. Results indicated an increase in community understanding of circular economy principles and sustainable waste management. The LOF produced proved effective in enhancing plant growth and opened opportunities for eco-friendly local entrepreneurship. This program demonstrates that combining educational and practical strategies can significantly strengthen community awareness and capacity in independently managing organic waste in a sustainable manner.

Keywords: waste management; liquid organic fertilizer; community education; circular economy; sustainability

1. INTRODUCTION

Modern waste management technologies play a vital role in addressing the escalating global waste crisis, requiring both technological innovations and sociocultural adaptations (Czekała et al., 2023). Among various strategies, composting stands out as a sustainable method for organic waste management. Recent advancements—such as the use of microbial inoculants and in-vessel composting—have significantly improved both the efficiency of decomposition and the quality of the resulting compost(Manea et al., 2024; Voss et al., 2024). The development of circular production models is now considered essential in mitigating resource depletion and environmental degradation (Lizundia et al., 2022). In this context, the valorization of agri-food waste represents a promising pathway for innovation in sustainable agriculture, aligning closely with the United Nations Sustainable Development Goals (SDGs) (Amran et al., 2021; Zhou et al., 2022). Transforming food waste into value-added products such as biocides, bio-based fertilizers, and biostimulants not only enhances crop productivity and plant health but also contributes to tackling global food waste issues (Pinela et al., 2024; Voss et al., 2024). However, several challenges persist, including the presence of contaminants, variability in compost quality, and socioeconomic obstacles to the widespread adoption of these technologies (Álvarez Salas et al., 2024; Manea et al., 2024).

Recent studies emphasize the potential of organic waste as an effective substitute for chemical fertilizers. Liquid organic fertilizers (LOF) (Widyabudiningsih et al., 2025), which can be derived from various urban waste materials—such as vegetable, fruit, and animal by-products—are rich in essential nutrients for plant growth (Haryanta et al., 2023). The use of bioactivators like Effective Microorganisms 4 (EM4) has been shown to accelerate the decomposition process and enhance the nutrient content of LOF (Pradiksa et al., 2022). Agricultural waste valorization not only addresses waste management issues but also aligns with the circular economy concept, providing economic and environmental benefits (Amran et al., 2021; Puglia et al.,

2021). Nonetheless, the need for proper processing remains critical to avoid environmental risks, such as heavy metal contamination in soil (Puglia et al., 2021; Szulc et al., 2021).

One location that generates substantial organic waste (approximately 5–10 kg per day)is the Angkringan Kampung Belimbing (AKB) restaurant, located in Mataram Village, Tugumulyo District, Musi Rawas Regency. As a popular culinary establishment, AKB produces daily waste in the form of food scraps, kitchen by-products, and wastewater. Unfortunately, this organic waste has not yet been managed or utilized to its full potential.

This community service initiative seeks to address this issue by introducing an accessible and environmentally friendly method for producing liquid organic fertilizer from restaurant waste. This method offers several advantages, including low production costs, simple processing techniques, and the effective utilization of locally available organic waste, making it feasible for community-level implementation. The liquid formulation enables faster nutrient uptake by plants and supports improvements in soil fertility while simultaneously reducing the volume of organic waste released into the environment, in line with circular economy principles. However, the method also has limitations, particularly related to variations in waste composition that may result in inconsistent nutrient content, as well as potential issues arising from improper fermentation processes, such as reduced fertilizer quality or odor generation, which underscores the importance of proper technical guidance and monitoring during implementation.

In addition, the activity empowers residents to acquire practical skills in processing household and restaurant waste into high-value agricultural inputs. It is hoped that this initiative will serve as a replicable model for waste management in other regions, contributing to the development of independent, environmentally conscious, and productive rural communities.

2. METHOD OF IMPLEMENTATION

This section describes the implementation method used in the community service activity conducted at Angkringan Kampung Belimbing (AKB) Restaurant, located in Mataram Village, Tugumulyo District, Musi Rawas Regency. The activity was carried out through several stages, starting from preparation to community education, training, and evaluation. Figure 1 presents a flowchart illustrating the overall stages of the LOF production–based community service activity at AKB, from initial observation and problem identification to training implementation and evaluation, providing a concise overview of the methodological framework.

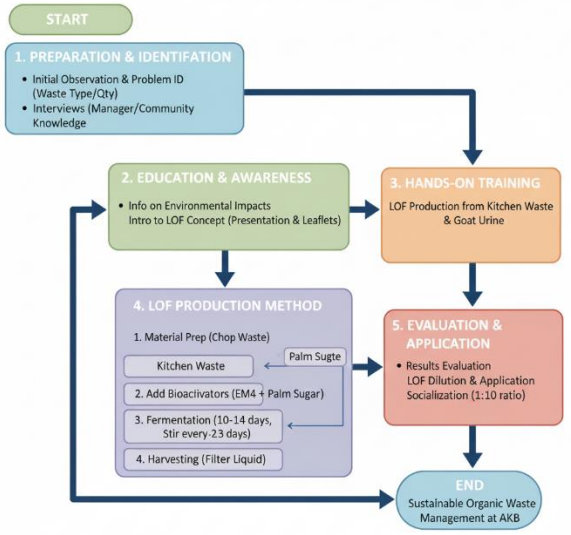

Figure 1. Flowchart of LOF Production Community Service at AKB

1. Stages of Activity

The implementation consisted of the following stages:

a. Initial Observation and Problem Identification

This stage involved direct observation of the types and quantities of organic waste produced daily by the AKB restaurant. Interviews were also conducted with the restaurant manager and surrounding community members to assess their knowledge and awareness regarding organic waste management.

b. Education and Awareness Campaign

The service team provided information on the environmental impacts of unmanaged organic waste and introduced the concept of converting kitchen waste into liquid organic fertilizer (LOF). This session was delivered through a short presentation and the distribution of informational leaflets.

c. Training on Liquid Organic Fertilizer (LOF) Production

A hands-on training session was held on how to produce liquid organic fertilizer (LOF) from kitchen waste using simple, low-cost, and easily replicable technology.

2. Materials and Equipment

Main Materials

- Kitchen waste (vegetables, rice, fruit peels) – freshly collected from AKB
- Palm sugar (local, 100%)
- Clean water
- EM4 Agriculture (PT Songgolangit Persada, liquid, pH 3.5)

Main Equipment

- Plastic fermentation drum (Lion Star, 60 L capacity)
- Knife
- Digital scale (Camry EK3650)
- pH meter (HANNA HI98107)
- Plastic bucket (Lion Star, 20 L)
- Stainless funnel (Nankai)
- Plastic bottles for packaging (PET, 1 L)

3. Equipment Setup

As illustrated in Figure 2, the equipment setup comprised a sealed plastic fermentation drum, a pH meter for monitoring fermentation conditions, auxiliary containers for material handling, and a funnel for filtration and transfer of the liquid organic fertilizer. This configuration supports controlled anaerobic fermentation and ensures the practicality and reproducibility of the LOF production process at the community level.

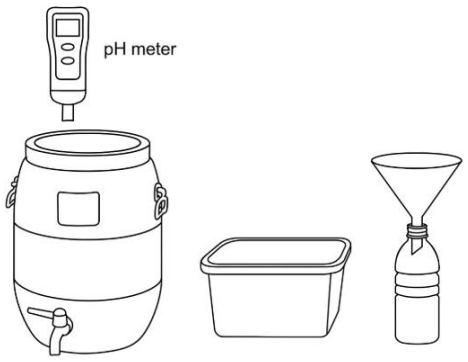

Figure 2. Main equipment used in the fermentation process of liquid organic fertilizer from the AKB restaurant kitchen waste

4. Liquid Organic Fertilizer (LOF) Production Method

The fermentation method used was anaerobic, following these steps:

- Material Preparation: Organic waste is collected, cut into smaller pieces to accelerate decomposition, and placed into a sealed fermentation container (such as a plastic bucket with a lid).
- Addition of Bioactivators: A microbial solution (EM4) and a carbohydrate source such as molasses, palm sugar solution, or rice washing water are added to facilitate the fermentation process.
- Fermentation Process: The mixture is stored in a shaded area for approximately 10 to 14 days. It is stirred every 2 to 3 days to maintain oxygen flow and support the growth of beneficial microbes.
- Harvesting: Once fermentation is complete, the liquid is filtered to separate solid residues, and the resulting solution is the liquid organic fertilizer. Before application, this LOF is typically diluted with water at a ratio of 1:10 for safe use on plants.

3. RESULTS AND DISCUSSION

1. Relevance of Waste Management Education in a Culinary Business Environment

One of the major challenges faced by small to medium-sized restaurants is the lack of an effective waste management system. Kitchen waste, such as vegetable scraps, fruit peels, and leftover rice, is often discarded directly into trash bins and accumulates at final disposal sites (landfills), which over time can pollute the environment, produce unpleasant odors, and foster the growth of disease vectors (Czekała et al., 2023).

The educational activity on organic waste management conducted at Angkringan Kampung Belimbing (AKB) restaurant provided essential insights to the owners, employees, and surrounding community on how to separate waste properly, recognize the potential of organic waste, and understand the environmental risks of poor waste handling. This initiative aligns with the principles of zero waste and circular economy, emphasizing waste reduction at the source and reusing waste into new, useful products (Lizundia et al., 2022).

As shown in Figure 3, the community education session involved restaurant employees and local participants in a structured socialization and training activity on organic waste management and liquid organic fertilizer (LOF) production. The session served not only as a knowledge transfer platform but also as a behavioral intervention aimed at encouraging participants to adopt environmentally responsible waste handling practices. The visual documentation highlights active participation and collective engagement, indicating a positive learning atmosphere conducive to behavior change.

Figure 3. Community Education on Waste Management at Angkringan Kebun Belimbing (AKB)

The education session also functioned as a behavior change agent. Participants began transitioning from the habit of indiscriminately discarding waste to collecting and processing it independently. This finding supports Manea et al. (2024), who argue that technological solutions in waste management are more effective when combined with structured social and educational interventions.

Pre- and post-tests conducted during the activity revealed a clear improvement in participants' understanding of organic waste management and circular economy concepts. As illustrated in Figure 4, the comparison of pre-test and post-test scores across ten assessment items shows a consistent increase in participants' performance following the educational intervention. The horizontal axis (Items 1–10) represents individual test questions assessing both conceptual and procedural knowledge, while the vertical axis indicates participants' scores expressed as percentages.

Specifically, pre-test scores ranged from 40% to 65%, indicating limited initial understanding of waste management principles and liquid organic fertilizer (LOF) production procedures. After the education and training activities, post-test scores increased substantially, ranging from 80% to 95%. The most notable improvements were observed in Items 5 and 6, which relate to procedural aspects of LOF production, where scores increased from 40–45% in the pre-test to 80% in the post-test. Similarly, Items 9 and 10, which assess understanding of LOF application and dilution practices, showed marked gains, with post-test scores reaching 90% and 95%, respectively. These results demonstrate that the training effectively enhanced both theoretical comprehension and practical skills among participants, reinforcing the role of structured community-based education in promoting sustainable waste management practices.

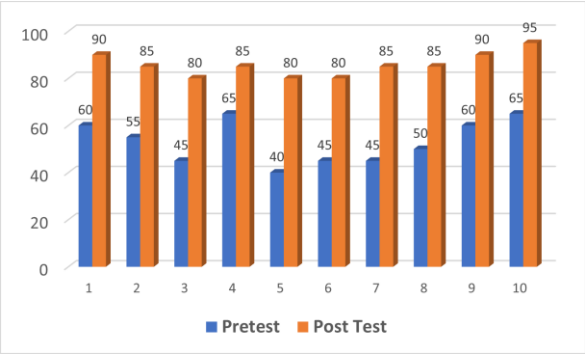

Figure 4. Comparison of Pre-Test and Post-Test Results of Participants

2. Innovation in Liquid Organic Fertilizer (LOF) Production

The production of liquid organic fertilizer (LOF) during the practical session utilized kitchen waste, including spoiled vegetables, fruit peels, and leftover rice, without the addition of animal-based materials to ensure suitability for a restaurant environment and to minimize odor generation. As illustrated in Figure 5, the LOF production process involved the anaerobic fermentation of organic waste using EM4 as a bioactivator and molasses as a microbial energy source. This approach accelerates organic matter decomposition and enhances nutrient availability in the resulting fertilizer, as supported by Pradiksa et al. (2022) and Haryanta et al. (2023), who noted that the use of bioactivators improves LOF quality and shortens fermentation time.

Figure 5. Process of Making Liquid Organic Fertilizer (POC)

The resulting liquid organic fertilizer (LOF) exhibited a dark brown color, a uniform texture after filtration, and a mildly fermented odor without any foul smell, indicating successful organic matter decomposition. As shown in Figure 6, the LOF was applied to water spinach (Ipomoea aquatica) and shallot (Allium cepa var. aggregatum) plants cultivated around the restaurant area. To evaluate its effectiveness, treated plants were compared with control plants of the same species grown under identical environmental conditions but without LOF application. Within 7 to 10 days after application, the treated plants showed visible

improvements, including the emergence of new shoots, greener leaves, and more vigorous growth, whereas the control plants exhibited relatively slower development.

Figure 6. Application of POC to Water Spinach and Shallot Plants

These findings are consistent with Voss et al. (2024), who assert that fertilizers derived from organic waste can significantly enhance plant physiology and yield. The trial demonstrated that LOF made from household or restaurant waste can serve as an affordable and environmentally friendly alternative to synthetic fertilizers.

3. Strengthening Local Community Capacity and Empowerment

Beyond the technical success of LOF production, the activity also contributed to enhancing the capacity of the local community. Participants learned how to better use local resources, particularly organic waste previously viewed as worthless. This demonstrates that addressing environmental challenges can begin at the smallest level using simple technology.

From an empowerment perspective, the program opened up new avenues for environmentally friendly entrepreneurship. Some participants began considering the idea of regularly producing and packaging LOF for sale as a local organic agricultural product. This aligns with the concept of waste valorization promoted by Amran et al. (2021), which involves transforming waste into economically valuable products without harming ecosystems.

Moreover, the program fostered collaboration between restaurant owners and residents to develop a sustainable waste collection and sorting system. If maintained consistently, this system could serve as a community-based waste management model, replicable in other villages across Musi Rawas Regency.

Despite the positive outcomes, the initiative still faced several challenges. Some participants initially hesitated to use kitchen waste, perceiving it as dirty or useless. In addition, limited experience in fermentation led to minor errors, such as loosely sealed containers or improper molasses ratios. These challenges suggest the need for continued assistance, routine follow-ups, and hands-on mentoring to ensure long-term success and consistency in organic fertilizer production.

4. CONCLUSION

The community engagement activity at Angkringan Kampung Belimbing (AKB) demonstrated that a combined approach of education and practical training effectively improved waste management awareness and technical skills among small business owners and residents. The conversion of kitchen waste into liquid organic fertilizer and its application to food crops such as water spinach and shallots not only enhanced environmental hygiene but also revealed potential economic value from organic waste utilization. To ensure program sustainability, continuous mentoring, periodic technical training, and integration of LOF production into routine restaurant operations are recommended, along with collaboration with local farmer groups and support from village authorities and agricultural extension services, enabling this initiative to develop into a sustainable and replicable community-based waste management model.

5. ACKNOWLEDGMENT

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