

Utilization of Household Organic Waste through Education and Demonstration of Eco-Enzyme Production in Pulorejo Village, Dawarblandong District, Mojokerto Regency

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ABSTRACT

Household organic waste is one of the most common types of waste generated by communities and is often not managed optimally. This condition occurs in Pulorejo Village, Dawarblandong District, Mojokerto Regency, where some residents still dispose of organic waste directly without any processing. Improper waste management can cause environmental pollution, produce unpleasant odors, and potentially become a breeding ground for disease vectors. Therefore, efforts are needed to increase community knowledge and awareness regarding more environmentally friendly organic waste management. This activity aimed to educate the community about the utilization of household organic waste through the production of eco-enzyme. The method used in this activity was observation with a descriptive approach to describe the condition of waste management in the community, followed by counseling and a demonstration of eco-enzyme production involving direct community participation. The results of the activity showed an increase in community understanding and awareness regarding the utilization of organic waste into useful products. In addition, the community began to understand how to process kitchen waste into eco-enzyme, which can be used for household purposes. Through this activity, it is expected that the community will be able to independently implement organic waste management, thereby reducing household waste and creating a cleaner and healthier environment.

INTRODUCTION

Organic waste is a dominant component of the total waste generated by society. Organic waste can cause serious environmental problems, including water and air pollution, and can increase public health risks through the spread of disease and the proliferation of pests when it is not properly processed. In addition, inefficient organic waste management also has the potential to waste valuable resources. Organic waste management has become an increasingly urgent issue worldwide, especially in developing countries such as Indonesia. Organic waste, which includes food scraps, agricultural waste, and other organic residues, has the potential to degrade the environment if it is not managed properly. In Indonesia, for example, less than 5% of the organic waste produced is processed into compost, while most of it eventually ends up in poorly managed open dumping sites (Oskar et al., 2022; Yuniarti et al., 2021).

In 2023, approximately 60.44% of waste came from household activities, followed by 11.63% from market activities. By type, waste consisted of food waste (39.67%), plastic waste (19.15%), wood or twig waste (11.94%), paper or cardboard (10.94%), and other types (18.3%) (National Waste Management Information System, 2023). Indonesia's waste generation in 2023 reached 56.63 million tons. Only 39.01% (22.09 million tons) was properly managed. Most of the remaining waste was still disposed of in open dumping sites, which pollute the environment and do not meet modern waste management standards (Ministry of Environment/Environmental Control Agency, 2025). Based on these data, household waste has the highest percentage, especially food waste and fruit and vegetable residues (organic waste). Organic waste management is therefore one of the main challenges in maintaining environmental sustainability.

Pulorejo Village is one rural area that produces a relatively large amount of household organic waste. However, the utilization of this organic waste remains limited due to low levels of community knowledge and awareness regarding household-based waste management. Most organic waste is still discarded or burned, which has the potential to reduce environmental quality and contradict the principles of sustainable environmental management.

Waste management in the community still relies on an end-of-pipe approach, in which waste is collected, transported, and disposed of at a final disposal site. Large volumes of accumulated waste at final processing sites have the potential to release methane gas, which can increase greenhouse gas emissions and contribute to global warming. Waste decomposition through natural processes takes a long time and requires costly handling. The waste management paradigm that relies on the end-of-pipe approach should therefore be abandoned and replaced with a new paradigm of waste management. This new paradigm views waste as a resource that has economic value and can be utilized, for example as energy, compost, fertilizer, or industrial raw material. Waste management is carried out through a comprehensive approach from upstream, before a product that may become waste is produced, to downstream, when the product has been used and becomes waste that is then safely returned to the environmental medium (Prabekti, 2021).

One form of waste management that can be carried out is processing organic waste into eco-enzyme. The study by Pratamadina and Wikaningrum (2022) states that eco-enzyme is an advanced organic liquid produced from the fermentation of organic materials, sugar, and water, with a color ranging from light brown to cloudy depending on the organic material used. This process usually includes the use of vegetable or fruit waste to address waste management problems. By reusing these materials as environmentally friendly enzymes, this approach introduces a sustainable waste treatment method, reduces environmental impacts, and promotes a circular economy.

Eco-enzyme was first developed by Dr. Rosukon Poompanvong, a founder of the Thailand Organic Agriculture Association, who has conducted research since the 1980s (Novianti & Nengah Muliarta, 2021). Eco-enzyme was later introduced more widely by Dr. Joean Oon, a naturopathy researcher from Penang, Malaysia. According to the socialization materials of the Eco Enzyme Nusantara Community (KEEN), 70% of the waste disposed of at final disposal sites is organic waste, which causes unpleasant odors in the environment, reduces the plastic recycling rate, and creates risks of explosion and organic waste decomposition.

Eco-enzyme is a fermented liquid produced from organic waste originating from household kitchen residues, such as fruit peels and vegetable scraps that are not rotten. Eco-enzyme can accelerate biochemical reactions from nature and serves as an enzyme made from organic waste derived from non-rotten fruit peels and vegetables (Junaidi R. J., 2021). Eco-enzyme is often called a solution with one thousand benefits. It is produced by fermenting fruit peels and vegetable scraps from kitchen residues, brown sugar as molasses, and clean water. Eco-enzyme was introduced and developed by Dr. Rosukon Poompanvong from Thailand, who has conducted research for 30 years. According to Rosukon Poompanvong, eco-enzyme is seen as a liquid with one thousand benefits. By making eco-enzyme, we can reduce the production of synthetic chemical waste and plastic waste from household product packaging. By processing them into eco-enzyme liquid, we help reduce the burden on the earth while also adopting a lifestyle with minimal synthetic chemicals (Jannah, 2021).

This environmentally friendly practice not only reduces the burden of waste disposal but also encourages environmental conservation activities. Instead of allowing organic waste to overflow in landfills or undergo harmful burning, eco-enzyme production converts these materials into valuable resources. Thus, eco-enzyme not only supports environmental conservation but also produces useful outputs, such as organic fertilizer for soil improvement and disinfectant liquid (Hasanah, 2021).

The benefits of eco-enzyme liquid are abundant. In agriculture, it can be used to water plants and improve fruit quality. In animal husbandry, it can help remove fishy odors in aquariums and support fish health. In the household, this liquid can be used to wash fruit exposed to pesticide residues, as a substitute for floor-cleaning liquid, and for other purposes. For health-related uses,

it can be used to relax the feet by soaking them in warm water mixed with eco-enzyme liquid, to clean polluted indoor air, and as a body cleanser (Serly, Aviati, & Ginting, 2022).

Organic fertilizer is a material that has an important function in maintaining soil fertility naturally and safely. It does not use chemical substances, so it is safe for environmental health and other living organisms, and the agricultural products produced are healthy and do not harm the health of people who consume them. Based on its form, organic fertilizer is divided into solid and liquid fertilizer. Liquid organic fertilizer is a solution produced from decomposed organic materials derived from animal waste, plants, or humans and contains more than one nutrient element (Sari, Susi, & Rizal, 2021). This shows that eco-enzyme belongs to the category of natural liquid fertilizer because of its liquid form and because the nutrient elements that support its fermentation process are more than one.

During the fermentation of eco-enzyme, the following reaction occurs: $CO_2 + N_2O + O_2 \rightarrow O_3 + NO_3 + CO_3$. When the fermentation process is complete, it produces a liquid with a dark brown or brown color depending on the materials used, including the types of fruit peels, vegetables, and brown sugar. The final residue consists of fruit peels and vegetable remains that can be used as solid fertilizer (Sari, Taniwiryo, Andreina, Nursetyowati, & Irawan, 2022). Eco-enzyme liquid can then be used as: (1) a natural floor-cleaning liquid that is effective for cleaning dirt and germs; (2) a disinfectant that can be used as an antibacterial agent in bathing areas; (3) an insecticide, used to repel insects by mixing the enzyme with water and applying it using a spray bottle; and (4) a liquid for cleaning drains, especially small drains used for dirty water disposal (Neni Rochyani, 2021).

The process of making eco-enzyme also has positive impacts on the surrounding and global environment, including air, soil, and the economy. In terms of environmental benefits, during fermentation the enzyme produces O_3 gas, commonly known as ozone. Eco-enzyme is known to contain acetic acid (CH_3COOH), which is useful for killing germs, bacteria, and viruses. Eco-enzyme also contains lipase, amylase, and trypsin and can kill or inhibit pathogenic bacteria. In addition, eco-enzyme can produce NO_3 (nitrate) and CO_3 (carbon trioxide), which are needed by soil as nutrients. Economically, the production of eco-enzyme can reduce household spending on floor-cleaning liquids and insect repellents (Iswati R. S., 2021).

The community service activity in the form of education and demonstration of eco-enzyme production was carried out on January 28, 2026, in Pulorejo Village, Dawarblandong District, Mojokerto Regency. The activity was attended by 52 PKK women and took place at the Pulorejo Village Hall, Dawarblandong District, Mojokerto Regency. The implementation consisted of education and demonstration activities on eco-enzyme production. Figure 1 presents the process flow of the community service activity.



Figure 1: Flow of the Activity Implementation Process

Based on Figure 1, the following is the process of implementing the community service activity, which aimed to provide the community with an understanding of the utilization of household organic waste as raw material for producing eco-enzyme:

1. PREPARATION STAGE

This preparation stage began with an observation visit to the community service activity location in Pulorejo Village, Dawarblandong District, Mojokerto Regency, to identify community conditions, regional potential, and problems related to household organic waste management. At this stage, the community service team held discussions with village officials and community representatives to determine an implementation strategy that matched community needs. Coordination and permit arrangements for the activity were then carried out with the village authorities. The team also prepared the activity requirements, including educational materials, tools and materials for making eco-enzyme, counseling media, and supporting facilities and infrastructure to ensure the smooth implementation of the activity.

2. EDUCATION STAGE

The education stage was implemented through counseling and demonstration methods. The activity began with a presentation by the speaker on the definition of eco-enzyme, its benefits, the materials used, the production process, and its potential uses in daily life. After the material presentation, the activity continued with a direct demonstration of eco-enzyme production by the speaker in front of the participants. The demonstration was carried out systematically, starting from the sorting of organic waste materials, mixing the materials according to the proper composition, and explaining storage techniques and the fermentation process. Participants were given the opportunity to ask questions and discuss the material to improve their understanding.

3. ACTIVITY EVALUATION

This series of activities was carried out comprehensively up to the monitoring and evaluation stage. The evaluation stage was conducted to assess the results of the education and demonstration of eco-enzyme production among participants. The evaluation was carried out after the material presentation and demonstration through direct observation, a question-and-answer session, and interactive discussion with the participants. The evaluation results showed that participants experienced increased understanding of the definition, benefits, materials, and stages of eco-

enzyme production. Participants were able to explain the process of making eco-enzyme, starting from the sorting of organic waste, the ratio of ingredients, and the correct fermentation process. In addition, participants showed high enthusiasm, indicated by their active participation in asking questions and discussing during the activity. Through the demonstration, participants also gained practical skills in making eco-enzyme, so they are expected to be able to apply the practice independently in their households as an effort to utilize organic waste and reduce household waste.

RESEARCH METHOD

This study used an observation method with a descriptive approach. Observation was conducted to determine the process of making and utilizing eco-enzyme from household organic waste in Pulorejo Village. The observation was carried out directly by observing the materials used, the stages of eco-enzyme production, and community involvement in the process.

Data were collected through direct observation of the education and demonstration activities for eco-enzyme production carried out at the village hall. The researchers recorded various information related to the types of organic waste used, the fermentation process, and community understanding of the benefits of eco-enzyme for the environment. In addition, observation was also conducted on the responses and participation of the community during the activity.

The data obtained from the observations were then analyzed descriptively to describe how household organic waste was utilized through eco-enzyme production and how this activity affected the improvement of community knowledge regarding environmentally friendly waste management.

RESULTS AND DISCUSSION

The implementation of the community service activity in the form of education and demonstration of eco-enzyme production in Pulorejo Village, Dawarblandong District, Mojokerto Regency, ran well and received a positive response from the participants. The activity was attended by 52 PKK women who actively participated throughout the entire series of activities. The results of the activity were analyzed based on the achievement of program objectives, the level of participant understanding, the practical skills obtained, and changes in community attitudes toward household organic waste management.

1. IMPLEMENTATION OF EDUCATION ACTIVITIES ON ORGANIC WASTE MANAGEMENT

The education activity began with the delivery of material on household organic waste problems, their environmental impacts, and the importance of household-based waste management, as shown in Figure 2. Based on the initial observation, most participants still had the habit of disposing of organic waste directly into trash bins or burning it without further processing. This indicated that community understanding of the concept of sustainable waste management was still limited.



Figure 2: Presentation of Eco-Enzyme Material

Through the counseling activity, participants gained new knowledge about more comprehensive household organic waste management. Participants began to understand the types and characteristics of organic waste, especially food, fruit, and vegetable residues that decompose easily but can cause environmental problems if not properly managed. In addition, participants gained an understanding of the impacts of organic waste accumulation on health and the environment, such as unpleasant odors, the development of disease vectors, and the potential for water and air pollution. The counseling material also introduced the concept of reduce, reuse, and recycle (3R) as a basic approach to sustainable household-level waste management. In this activity, participants were introduced to the utilization of organic waste into useful products through eco-enzyme production, so that waste previously considered useless could be processed into an environmentally friendly liquid with various functions, such as a natural cleaner and liquid organic fertilizer. This understanding encouraged a change in participants' perspectives on organic waste, from something that was simply discarded to a resource that could be productively reused.

2. RESULTS OF THE ECO-ENZYME PRODUCTION DEMONSTRATION



Figure 3: Demonstration of Eco-Enzyme Production

The demonstration stage was conducted through direct practice. Figure 3 shows the process of making eco-enzyme using simple materials that are easily obtained in the household environment, namely fruit and vegetable waste, brown sugar/molasses, and water in a ratio of 3:1:10. Making eco-enzyme is a simple and useful process, both for reducing organic waste and for producing a natural product that can be used in various aspects of daily life. The following are the steps and materials needed to make eco-enzyme:

Materials:

- Fruit and vegetable scraps: Fruit peels, seeds, or other parts of fruits and vegetables that are usually discarded can be used. Common fruits used to make eco-enzyme include pineapple peels, orange peels, mango, and apple.
- Sugar: Brown sugar or coconut sugar is usually used because both are more natural and contain minerals that are beneficial during the fermentation process.
- Water: Clean water is needed to dissolve the sugar and support the fermentation process.

Production Process:

- Mix the ingredients: Use approximately 1 part fruit and vegetable scraps, 1 part sugar, and 3 parts water. For example, for every 1 kg of fruit or vegetable scraps, add 1 kg of sugar and 3 liters of water.

- **Fermentation:** Place the mixture in an airtight container, such as a bucket or large bottle that can be tightly closed. The container should be kept in a cool place and protected from direct sunlight, such as in a cupboard or dark room. Allow the mixture to ferment for 3 months. During this period, microorganisms will decompose the organic materials and produce beneficial enzymes and organic acids.
- **Stir periodically:** Every 2-3 days, open the container and stir the mixture to accelerate the fermentation process. This also helps prevent mold formation on the surface of the mixture.

According to Chahaya et al. (2022), several points should be considered to obtain good fermentation results:

1. The waste used should consist of various types so that the bacteria produced are more diverse.
2. Place the fermentation solution in a location with good airflow and no direct exposure to sunlight.
3. Do not repeatedly open and close the container, and make sure the container remains tightly closed during the fermentation process.
4. Ensure that the container is always clean.

The fermentation process is carried out for 90 days. The first 30 days produce alcohol and acetic acid, which have disinfectant properties and can only be applied to plants because they contain carbohydrates (sugar). The second 30 days produce vinegar, and the third 30 days produce eco-enzyme that is ready to be harvested (Koniherawati & Martini, 2022). The eco-enzyme fermentation process does not always run smoothly, and several common failures may occur. If maggots or black mold appear during the incubation period, they can be removed by placing the eco-enzyme solution under sunlight for 2-4 days until the black mold and maggots disappear. The fermentation process can then be continued by closing the eco-enzyme container again and leaving it until the solution can be harvested (Parwata et al., 2021). Successful eco-enzyme that is ready for harvesting generally has white mold, an alcoholic and acidic smell, and a mature liquid. The eco-enzyme liquid is harvested by filtering it into a clean container and can be stored properly without an expiration date, while the residue can also be used as plant fertilizer (Murdiana et al., 2022).

Filtering and Maturation:

- After approximately 3 months of fermentation, the liquid should be filtered. Use gauze or a strainer to separate the fruit and vegetable residues from the mature eco-enzyme liquid.
- **Storage:** Store the filtered eco-enzyme liquid in a closed container in a dark and cool place for another 2 to 3 weeks. This allows the eco-enzyme to reach an optimal level of maturity so that it is more effective when used. Mature eco-enzyme liquid has a rather sharp smell, similar to vinegar, but it is not dangerous. Make sure the bottle or storage container has adequate ventilation so that the fermentation process runs smoothly.



Figure 4: Explanation of the Benefits of Eco-Enzyme

4. UTILIZATION OF ECO-ENZYME FOR PLANTS

With its many benefits, eco-enzyme can be used as liquid organic fertilizer, as well as a natural insecticide and pesticide for plants. Figure 4 explains the use of eco-enzyme (EE) as liquid organic fertilizer, natural insecticide, and pesticide for plants. EE has a positive influence on increasing plant production and growth. Several studies have reported the effects of EE on plants, using different EE materials and applying it to several types of plants.

a. Use of eco-enzyme as a decomposer.

Eco-enzyme can function as a decomposer in compost fertilizer by catalyzing the fermentation process and improving the quality of the final compost produced. Narang et al. (2023) reported that the addition of eco-enzyme improved the nutritional quality and final result of the compost produced, and that the application of compost and eco-enzyme to common bean plants improved their growth and production. In addition, eco-enzyme can also be used in livestock industry wastewater before it is discharged or released into the environment. Sambaraju and Lakshmi (2021) reported that the use of eco-enzyme in wastewater from dairy farms helped reduce biological oxygen demand and chemical oxygen demand values and helped accelerate the waste treatment reaction by breaking down complex organic compounds into simpler organic compounds that can be absorbed.

b. Direct use of eco-enzyme on plants.

Eco-enzyme can be applied to all types of plants and at every stage of plant growth, from seeds to the period before harvest. As reported by Vama and Cherekar (2021), seeds treated with eco-enzyme germinated faster and were more resistant to pests and diseases. Eco-enzyme can also affect plant growth and production as well as the health of planting land. Mandal and Verma (2023) reported that plants treated with eco-enzyme showed significant differences in the growth and

production attributes of radish. The application of eco-enzyme to sweet potato plants increased tuber production and leaf area meter (LAM) values and improved the optimal condition of the land. The application of eco-enzyme to turi plants (*Sesbania grandiflora*) had a significant effect on plant height, leaf width, and number of flowers. Eco-enzyme can also be applied in the form of liquid fertilizer to plants. Satrio et al. (2023) reported that the use of eco-enzyme-based liquid fertilizer on plants significantly increased the morphology and production of leek plants (*Allium porrum*). In addition to being used as liquid organic fertilizer, eco-enzyme can also be combined with special fertilizers in hydroponic cultivation. Eco-enzyme combined with AB mix influenced the dry matter production of green mustard. Eco-enzyme can also be combined with biochar or activated charcoal to optimize the effects of each material. Tamin et al. (2023) reported that eco-enzyme interacted with biochar in increasing the growth and production of pakcoy plants. The application of eco-enzyme can also affect the nutrient content of plants, as reported in studies showing that eco-enzyme had a significant effect on potassium content in chili plants.

The demonstration of eco-enzyme production became an important part of the knowledge transfer process because participants were able to directly observe the correct stages of production. The demonstration used materials that are easy to obtain in the household environment, namely fruit and vegetable waste, brown sugar or molasses, and water in a specified ratio. The implementing team demonstrated the process starting from the sorting of organic materials, cutting the materials to accelerate fermentation, mixing the materials according to the proper composition, and storing them in a closed container during the fermentation period. Through this demonstration, participants gained practical understanding of the principles of fermentation and the factors that influence the success of eco-enzyme production.

3. EVALUATION OF INCREASED PARTICIPANT KNOWLEDGE AND SKILLS



Figure 5: Discussion and Question-and-Answer Session

The activity evaluation, conducted through observation, discussion, and question-and-answer sessions, showed an increase in participants' knowledge and awareness after attending the activity. Participants not only understood the concept of eco-enzyme but also showed motivation to make eco-enzyme independently at home. Their enthusiasm was reflected in further discussions about the possibility of developing similar activities at the PKK group level and applying them routinely in household waste management. This indicates that the education activity was able to encourage a change in community perception of waste, from something previously regarded as waste into a resource with economic and environmental benefits.

4. IMPACT OF THE ACTIVITY ON COMMUNITY ENVIRONMENTAL AWARENESS

This activity had a positive impact on changing community mindsets in viewing organic waste. Before the activity, waste was considered something that had to be discarded, whereas after the activity the community began to understand that organic waste is a resource with useful value. This change in perception is an initial step toward community-based waste management. Eco-enzyme education also supports the concept of the circular economy, in which household waste can be reused as beneficial and environmentally friendly products. More broadly, this activity had a positive impact on community empowerment efforts in environmental management. PKK women, as the main managers of household activities, have a strategic role in reducing waste generation at the source. With increased knowledge and skills, it is expected that organic waste processing practices can be carried out sustainably and become a new habit in daily life. A

community participation-based educational approach has proven effective in building collective awareness and strengthening community capacity to address local environmental problems.

5. DISCUSSION OF THE RELATIONSHIP WITH THE CONCEPT OF COMMUNITY EMPOWERMENT



Figure 6: Group Documentation with PKK Women

The success of the activity shows that a community empowerment approach through participatory education can improve community capacity to address local environmental problems. Figure 6 shows that the involvement and active participation of PKK women became a strategic factor because this group plays an important role in household management, including domestic waste management. The results of this activity also show that eco-enzyme is a relevant alternative for organic waste management in rural areas because the production process is simple, low-cost, and uses readily available raw materials. The utilization of eco-enzyme not only contributes to reducing the volume of household waste but also supports the concept of a circular economy through the reuse of waste into useful products. Thus, the education and demonstration activity on eco-enzyme production in Pulorejo Village can serve as an initial step in encouraging behavioral change toward independent, environmentally friendly, and sustainable household waste management.

CLOSING

CONCLUSION:

The community service activity through education and demonstration of eco-enzyme production in Pulorejo Village aimed to increase community knowledge, awareness, and skills in managing household organic waste independently and sustainably. Based on the implementation of the

activity, it can be concluded that a participatory educational approach combined with direct practice is an effective strategy for increasing community capacity in organic waste management. The main findings of the activity show that education accompanied by direct practical demonstration was able to change community understanding from the paradigm of disposing of waste to utilizing waste as a valuable resource. Participants not only understood the concept of eco-enzyme theoretically but also gained practical ability in its production process and awareness to apply it in their household environment. This indicates that eco-enzyme is an applicable, simple, and suitable alternative for organic waste processing in rural communities. Thus, this activity demonstrates that community empowerment through practice-based education can support environmentally friendly behavioral change and serve as an initial step in independent and sustainable circular-economy-based household waste management.

SUGGESTIONS:

Based on the results of the activity, several suggestions can be offered as follow-up actions. Continuous assistance should be provided to the community so that the practice of making eco-enzyme can be applied consistently and become a habit in daily household waste management. In addition, the village government together with PKK groups are expected to develop follow-up programs, such as forming eco-enzyme management groups that function as monitoring media, platforms for sharing experiences, and efforts to strengthen environment-based community empowerment. Similar educational activities are also recommended to be expanded to other community groups, such as youth and students, in order to foster environmental awareness from an early age and broaden the impact of organic waste reduction in the community. Furthermore, future community service activities can be directed toward measuring long-term impacts, including reductions in household waste volume and the potential development of eco-enzyme as an economically valuable product that can increase community independence.

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