Bubungan Tinggi: Jurnal Pengabdian Masyarakat
http://ppjp.ulm.ac.id/journals/index.php/btj/index
e-ISSN: 2722-3043 p-ISSN: 2722-2934
Vol 7 No 2 2025
DOI: https://doi.org/10.20527/btjpm.v7i2.14283

Socialization and Training on the Production of Eco Enzyme from Agricultural Waste for Farmer Groups

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Article Info

Article history:
Received: December 11, 2024
Accepted: February 5, 2025
Published: May 16, 2025

Keywords:
Agriculture
Community service
Eco Enzyme
Jayawijaya
Waste

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Abstract

Walesi Village in the Walesi District is a region in Jayawijaya Regency with fertile land. The community does not use fertilizers in crop cultivation. The challenges faced by the farmers in Walesi village are low agricultural literacy and a focus on conventional farming. This activity aims to enhance the community's ability to utilize agricultural waste with eco enzyme. This activity was conducted on October 10 and 19, 2024, with 20 and 27 farmers participating in the combined Nitnen Nithesik farmer groups. The method used included socialization and training in the production of eco enzyme. The results showed an improvement in the community's capabilities with indicators such as understanding the types of waste at 90%, understanding the benefits of eco enzyme at 86%, understanding the steps in making eco enzyme at 64%, and producing eco enzyme at 51%. This service activity has a very big role in supporting sustainable agriculture in Walesi village, Jayawijaya Regency.

To cite this article: Takdir, E., Vernanda, V., Giban, A., & Huby, F. (2025). Socialization and training on the production of eco enzyme. *Bubungan Tinggi: Jurnal Pengabdian Masyarakat*, *7*(2), 533-541.

INTRODUCTION

The Baliem Valley is a mountainous area with fertile soil that can be used as an agricultural area. One area that has enormous potential for agricultural progress is the Walesi District. This is proven by various superior products from food, industrial, and horticultural crops originating from the district, such as soybeans, coffee, strawberries, vegetables, sweet potatoes, and chilies. Of these commodities, soybeans have received significant attention in several areas because of their land suitability and more promising results compared to other crops. However, farmers still experience many obstacles in management and agricultural production, which cause reduced soybean yields. Soybeans themselves are the third most important food crop after rice and corn. Even though the land in the Baliem Valley is fertile, if it is used for farming continuously without adding nutrients, the land will one day be degraded. Thus, the soil is no longer capable or suitable for the growth of soybean plants. Therefore, agricultural innovation is needed by utilizing abundant agricultural waste with little capital. Innovation in the use of agricultural waste will support a sustainable agricultural system.

The farmers' obstacles in Walesi village face are that agricultural literacy is still low, and agriculture is more focused on conventional farming. This is due to a lack of agricultural innovation in plant cultivation, fertilizer and pesticide production, product quality testing, high weed populations, and uneven rainfall. Agriculture in the Baliem or

Walesi Valley emphasizes organic farming; using inorganic materials or organic fertilizers is not recommended in cultivating plants. Therefore, farmers must be more innovative in utilizing natural materials, such as agricultural residues or agricultural waste, into organic materials that benefit soil fertility, one of which is by processing waste with eco enzyme.

Eco enzyme include organic fertilizers that are available in liquid form. This liquid organic fertilizer has the advantage that plants will more easily absorb the nutrients contained in the fertilizer (Basuki et al., 2023). Galintin et al. (2021) state that Eco enzyme are liquids made by fermenting organic waste. The general public also expresses this opinion (Rachman et al., 2023) that eco enzyme are made from organic waste such as fruit peels, fruit dregs, and vegetables, which are processed through fermentation. It has a characteristic brown color and a strong fermented, sweet, and sour odor. Dr. Rosukon Poompanvong, the first founder of the Thai Organic Farming Association, was the first to introduce Eco enzyme.

The ecoenzyme variant has a fresh and sour aroma (Viza, 2022). However, the combination of fruit or vegetable peel waste used as raw material for ecoenzyme production still influences the color, odor, water content, and pH value of the ecoenzyme produced (Sihite, 2024). In principle, the process of making eco enzyme is similar to making compost. The difference is that water is added to the growth medium so that the final product produced is a liquid, which is preferred because it is easier to use. Apart from that, this ecoenzyme does not require large areas of land for the fermentation process, such as making compost, and this product does not even require a compost tank with certain specifications (Septiani et al., 2021).

This community service activity is expected to bring new changes for farmers in making fertilizer, especially organic fertilizer, namely, coenzymes. This is in accordance with the aim of this service, which is to provide understanding and increase the community's ability to utilize agricultural waste with coenzymes.

METHODS

The PAR (Participatory Action Research) method is a service method that involves active participation from partner farmer groups. The selection of this activity is based on aspects of fulfilling community needs for producing eco enzyme and developing science. Meanwhile, participants were selected directly based on farmer groups cultivating soybean plants. This community service was carried out in two stages, namely the first stage in the form of socialization on Thursday, 10 October 2024, and the second stage in the form of training on Saturday, 19 October 2024, which was located in Walesi village, Walesi District, Jayawijaya Regency.

Paper, a ballpoint pen, a laptop, and a printer are the tools and materials used in socialization activities. Buckets, jerry cans, funnels, machetes, scales, dippers, knives, EM4, brown sugar, water, and agricultural waste (vegetable and fruit remains) are used in training activities. The stages for implementing this community service activity have been designed according to Figure 1.

The details of the activities or stages of implementing community service are as follows:

1. Conduct a survey at the location of the Association of partner farmer groups, namely in the Walesi district at PT Nitnen Nithesik, with four farmer groups. After that, the university carried out an analysis of partners' needs for empowerment assistance. This activity was carried out by meeting directly with the head of the Gapoktan and the head of the farmer group to discuss the obstacles in the farmer group.
2. Before providing socialization, a pre-test is given to activity participants to assess the community's initial abilities regarding the activities to be held. This pre-test involves asking participants several questions related to the material. The students involved in

this activity made it easier to communicate with the participants, who mostly used the local language.

3. Provide the first socialization stage to partners regarding the objectives of community service activities. The partners here are a combination of farmer groups that provide agricultural land as a place to analyze agricultural waste and utilize agricultural waste. This socialization was attended by all PT Nitnen Nithesi management and all farmer group members to build familiarity and make it easier to carry out community service activities later. Next, the second socialization stage is carried out by delivering material about the use of agricultural waste for cultivating soybeans. The aim is for people to know more about agricultural waste and how to process this waste into useful and environmentally friendly products.
4. Organizing workshops/training on making eco enzyme from agricultural waste. This workshop is based on an agreement with a combination of partner groups, with implementation remaining at the partner location. This workshop or training on making eco enzyme aims to open insight and increase people's knowledge and skills in making eco enzyme. The activities carried out:
    a. Prepare tools and materials for making eco enzyme derived from partner agricultural waste;
    b. Processing the prepared materials and then putting them into the eco enzyme storage area
    c. Close the eco enzyme reservoir and store it in a place that is not exposed to direct sunlight.
    d. Wait for the fermentation of the ingredients for +-90 days.
5. The final stage of implementing the post-test is to determine the increase in community capacity after comparing it with the pre-test results.

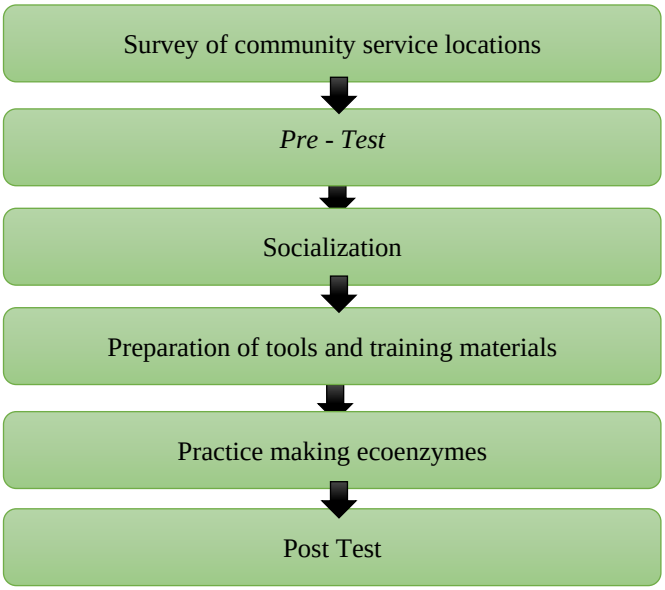

Figure 1 Flowchart of PKM implementation

RESULTS AND DISCUSSION

This service activity is divided into two activities: socialization on using agricultural waste with eco enzyme and training on making eco enzyme. During the socialization, the presenters made several PowerPoint slides about the titles chosen. During the

implementation of PKM, the condition of the activity location in the farmer group's garden meant that the material could not be displayed in focus because the power source was far from the location where the activity was carried out. However, the presenter prepared the material in hard copy so participants could get a copy. The materials provided in this activity are understanding agricultural waste, types of agricultural waste, making eco enzyme, and applying eco enzyme.

Garbage or organic waste, such as fruit and vegetables, will rot easily. Waste disposed of directly without management can pollute the air, land, water, rivers, and sea. Methane gas is produced from organic waste that is disposed of without management (Pakki et al., 2021).

Organic waste can also come from pre-harvest, harvest, and post-harvest activities carried out by the community, and it is known as agricultural waste. Apart from that, agricultural waste can also be classified into waste from food crops, horticulture, plantations, and industrial crops. Based on its form, agricultural waste can be divided into solid, liquid, and gaseous forms.

Converting organic waste into coenzymes is one way to reduce or utilize agricultural waste into something more useful. Eco Enzymes are made by fermenting remaining organic materials under anaerobic conditions with the help of living organisms derived from organic materials (Pakki et al., 2021).

Eco Enzyme Water can convert ammonia into nitrate (N03), a natural hormone and plant nutrition. Because it contains macro and micro nutrients, it can be used as a liquid organic fertilizer (POC).

The principles of environmentally friendly agriculture, also known as sustainable agriculture, depend on using organic fertilizers (Mayrowani, 2016). Organic fertilizer is hoped to help build a zero-waste agricultural system, meaning that agricultural waste such as straw and crop residues can be returned to the soil to maintain and thin out waste (Mulyati et al., 2020).

In the agricultural sector, eco enzymes have been widely used as a soaking solution during the seed selection and seed breeding process for rice, as a liquid organic fertilizer for pak choy mustard plants (Kamila & Winarsih, 2023; Novriani, 2019), as an organic material changer, growth stimulant, pest and plant disease control, and an increaser of soil nutrient content (Lumbanraja et al., 2020).

Eco enzyme have many benefits, such as plant growth factors, floor cleaning detergent mixtures, pesticide residue cleaners, scale cleaners, and car radiator temperature reducers (Astuti et al., 2020). Liquid organic fertilizer accelerates plant growth and development.

This socialization activity was conducted on October 10, 2024, from 13.00 to 17.00 WIT at the Nitnen Nithesik Jaya Farmer Group Joint Office in Walesi Village, Walesi District, Jayawijaya Regency.

This activity was attended by 20 farmers who are members of the Nitnen Nithesik Jaya farmer group. The implementation of socialization begins with the community filling out the pre-test, which is accompanied by students filling in the pre-test. The next event was the association of the Head of the Farmer's Group "Amatus Yelipele" which motivated its members to be enthusiastic about participating in activities like those carried out. Next, the material will be delivered by the service team. When delivering the material, the team immediately gave the hard file to the participants and explained. This activity is as shown in Figure 2 (a). After the presentation of the material, there was a group photo in the yard of the Nitnen Nithesik Jaya Farmers Group office (Figure 2 (b)).

(a) (b)

Figure 2 (a) Distribution of material to participants and (b) Group photo after socialization activities

Then, they continued delivering the material distributed to the activity participants. After delivering the material, they continued with a discussion stage with farmers. The enthusiasm of the community was visible during the discussion session. Several people asked questions such as: Can all agricultural waste be processed into coenzymes? What is EM4? How long are coenzymes stored? Where should they be stored, etc. After the discussion ended, plans for the next activity were delivered.

The second activity is training farmer groups on October 19, 2024, at the Nitnen Nithesik Jaya Farmer Group Farm in Walesi Village, Walesi District, Jayawijaya Regency. Twenty-seven participants attended this activity, who were directly assisted in making eco enzyme. The activities carried out:

a. Prepare tools and materials for making eco enzyme derived from partner agricultural waste. According to Rubin (2001), Eco Enzyme uses cheap and young raw materials, and the fermentation process lasts for three months, which requires patience. However, this solution has many great benefits. The fermentation process produces oxygen gas, also known as ozone, essential for the Earth's atmosphere (Rubin, 2001).
b. Process the prepared ingredients and put them into the coenzyme storage container (see pictures 3a and 3b).
c. Close the ecoenzyme storage container and store it in a place not exposed to direct sunlight.
d. Wait for the fermentation of the ingredients for more or less 90 days.

(a) (b)

Figure 3 (a) Making eco enzyme and (b) Ecoenzyme container in close

After making the coenzyme, the post-test filling continued. Students accompanied this filling because several participants could not read or write. After completing the post-test,

all the tools used in making coenzymes were provided. After that, a closing and group photo session were held (See pictures 4a and b).

(a) (b)

Figure 4 (a) Group photo after making the ecoenzyme, and (b) Eco enzyme created with the community

During the service implementation, the team gave a post-test to participants to see the extent of farmers' knowledge about the use of agricultural waste, then carried out outreach and training to participants and a post-test afterwards. The pre-test and post-test given were 20 questions, which contained four indicator questions, namely how the community understands the types of agricultural waste, farmers' understanding of eco enzyme and their benefits, farmers' understanding of the sequence of making eco enzyme, and the community's ability to make eco enzyme. The processing of pre-test and post-test results is presented in Table 1.

Table 1 PKM result indicators

No	Indicator	Before	After
1	Partner understands the types of agricultural waste	49 %	90 %
2	Partners understand eco enzyme and their benefits	37 %	86 %
3	Partners understand the order of making eco enzyme	8 %	64 %
4	Partners are able to make eco enzyme independently	4 %	51 %

Table 1 shows the following points:

1. Partners understand the types of agricultural waste: Before the training, only 49% of partners understood the types of agricultural waste, but after the training, the figure rose drastically to 90%. This shows that training is very effective in providing knowledge about various types of agricultural waste that can be utilized.
2. Partners understand coenzymes and their benefits: Before the training, only 37% of partners understood what coenzymes are and their benefits. After training, 86% of partners had a good understanding. This significant increase indicates that the material about eco-enzymes was delivered very well, so almost all partners now understand the concept and benefits.
3. Partners understand the order of making coenzymes: Before training, only 8% of partners understood the order of making eco enzymes, but after training, this increased to 64%. While this increase is significant, it shows there is still room for more mentoring and practice to make partners more adept at understanding the manufacturing process.
4. Partners are able to make eco enzyme independently: Before the training, only 4% of partners were able to make eco enzyme independently, but after the training, the figure increased to 51%. This is a good achievement, but half of the partners still need additional support to achieve full independence in ecoenzyme manufacturing. This

result is the lowest of the four indicators observed. This is because in making eco enzyme several stages go through. And during the observations, several participants forgot the sequence of making eco enzyme.

5. Overall, the training had a very positive impact on increasing partners' understanding and skills regarding using agricultural waste with eco enzyme. This will allow agriculture in Walesi to continue implementing organic farming, which can maintain environmental conditions such as soil, water, and air and prevent damage to agricultural land that can be used for the next generation.
6. The statement from the Chairman of the Joint Group, Mr. Amatus Yelipele, is that farmers have never carried out innovation in making organic fertilizer and there has never been any training related to the use of agricultural waste, therefore there is a need for socialization or training related to this matter to increase the agricultural potential in the target groups and on the Jayawijaya scale. The hope is that by partnering with the campus, we can further empower existing agricultural potential to help farmers become role models for farmers in the Walesi District, Jayawijaya Regency. One is by carrying out training related to making organic fertilizer, which can improve the quality and quantity of cultivated plants.

CONCLUSION

The community service activities in the form of socialization and training on the use of agricultural waste with eco enzyme in the Walesi farmer group have great potential in supporting sustainable agriculture. This activity went well and was very beneficial for the community. From this activity, it was discovered that several parts needed attention, such as the production of eco enzyme, which were still little known to the public. So, there is a need for further activities that can further improve the community's ability to make organic fertilizer. The next activity will continue to be carried out at the Nithnen Nithesik Jaya farmer group because it has many members and the areas where they work.

Each author has an important role in implementing this community service. Nuraisyah Takdir is responsible for activity coordination, ensuring the smooth running of socialization and training. Futri Wulandari prepared socialization materials and provided presentations to participants. Vedrix Vernanda led practical training sessions and accompanied participants in applying the material. Arli Giban is responsible for documenting all activities and compiling evaluation reports. Meanwhile, Fheronika Huby coordinates with partners and participants to ensure program sustainability.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS STATEMENT

The team leader is responsible for: (1)Designing and compiling community service program proposals, (2) Coordinating internal teams and external communication with partners (farmer groups and village officials), (3) Compiling main training materials covering soybean harvesting, threshing, drying, and storage techniques, (4) Arranging activity schedules and ensuring program implementation according to the specified time, (5) Monitoring and evaluating activities, and (6) Compiling final reports on community service activities. Duties of lecturer members: (1) Compiling and providing training materials on simple technology for harvesting and post-harvest, (2) Conducting demonstrations of threshing and drying tools, (3) Providing direct practical training to participants, (4) Providing technical guidance (leaflets or modules) on proper handling of soybean harvests, (5) Facilitating focus group discussions (FGD) to explore partner issues,

(6) Compiling targeted extension methods for farmer groups, (7) Encouraging the formation of farmer study groups as a form of program sustainability, and (8) Prepare participatory-based evaluation instruments with students.

ACKNOWLEDGMENTS

The community service team would like to express its deepest gratitude to DRTPM 2024 for allowing our community service team to carry out service with an empowerment scheme for the community with contract number 077/E5/PG.02.00/PM.BATCH.2/2024, as well as to the Nitnen Nithesik Jaya farmer group in Walesi.

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