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Improving the Skills of Farmers and Women Farmers Groups in Belantih Village, Bangli, in Making Waste-Based Organic Fertilizer

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A B S T R A C T

This community service initiative, conducted on June 21, 2025, addressed the dual challenges of inorganic fertilizer scarcity and environmental pollution in Belantih Village, Bangli. The program aimed to empower the Dharma Kriya and Widya Pertiwi farmer groups by enhancing their skills in converting organic waste into valuable solid and liquid fertilizers. The activity employed a hands-on training methodology, which included a theoretical session followed by practical implementation and a final evaluation. The findings revealed a significant increase in participant knowledge, with 95% of respondents reporting a comprehensive understanding of the material and methods, and the remaining 5% reporting a good grasp. All 20 participants expressed a strong desire to adopt the new skills. Specifically, 80% expressed high satisfaction and interest in applying the techniques to improve the quality of their intercropped citrus and coffee plants. In comparison, the remaining 20% were eager to implement the process for personal use. This project successfully demonstrated that a practical, hands-on approach can effectively transfer knowledge and motivate community members to embrace sustainable practices. The adoption of these waste-processing techniques provides a viable and environmentally friendly solution for mitigating fertilizer shortages while simultaneously enhancing agricultural productivity and reducing pollution.

Contribution to Sustainable Development Goals (SDGs):
SDG 2 -Zero Hunger
SDG 12 Responsible Consumption and Production
SDG 13 Climate Action
SDG 15 Life on Land

1. INTRODUCTION

1.1. Research Background

Village is located in the Kintamani District, Bangli Regency. It possesses significant and superior natural resources, notably as a central producer of Siam citrus fruit. Consequently, it is unsurprising that citrus trees dominate the local plantations and farmlands. The village encompasses an area of 9.06 km² and is situated at an altitude of 800–900 meters above sea level, with a population of 2,355 people [1].

The Dharma Kriya Farmers Group and the Widya Pertiwi Women Farmers Group are agricultural groups based in Belantih Village. The primary challenge faced by farmers in these groups is that, despite the village's status as a citrus production center, its cultivation and agribusiness have not yet achieved the ability to provide substantial prosperity for the farmers. Belantih Village boasts potential natural resources as a production center for citrus, coffee, and vegetables, which are grown as intercrops—a practice

often referred to as intercropping. This intercropping system combines short-life-cycle and long-life-cycle plants to ensure sustainable family income. This strategy is crucial because coffee and citrus are harvested only once a year. In contrast, vegetables, such as chilies, have a faster growth cycle and can be harvested multiple times from a single plant. Furthermore, the harvest seasons for citrus and coffee are staggered.

The primary factor contributing to the low yield and quality of the intercropping harvest is the limited capacity of farmers to adopt evolving cultivation technologies, specifically Good Agricultural Practices (GAP), particularly intensive maintenance such as balanced fertilization. This presents a dilemma for citrus farmers: achieving maximum yield with high quality requires providing nutrients through both organic and inorganic fertilization [3]. However, the high cost and occasional market unavailability of inorganic fertilizer compel farmers to rely solely on livestock manure (from chickens or cattle). This manure is often insufficiently composted, leading to environmental pollution, unpleasant odors, fly infestations, and increased fungal attacks on plants. Conversely, an abundance of organic materials and agricultural waste is readily available but underutilized. These include scattered coffee husks in plantations, unsold vegetable residues, citrus fruit rotten and dropped due to fruit fly infestations, banana stems (from trees commonly planted as garden fences), sintrong leaves (Crassocephalum crepidioides) typically considered weeds in citrus groves, and solid and liquid cattle manure. Other resources, such as rice-washing water and coconut water, are also often treated as waste. When properly processed, these materials can be converted into solid or liquid organic fertilizer. This practice offers a viable solution to mitigate the dependence on expensive and scarce inorganic fertilizers [4].

Another challenge faced by the partners is a lack of knowledge regarding methods to enhance the productivity of their intercropping systems. Furthermore, the partners lack the specific knowledge and skills required to process organic waste into quality, economically valuable organic fertilizer. The absence of equipment for converting agricultural waste into liquid organic fertilizer is a further constraint. The provision of such processing equipment would enable the partners to produce quality organic fertilizer products with economic benefits, thereby supporting the productivity of their intercropped plants. Although various solid and liquid organic fertilisers are commercially available, the development of these fertilisers using local materials—often considered waste—needs to be further advanced. These materials are, in fact, organic compounds rich in nutrients essential for plant growth and production. Processing this discarded organic waste into fertiliser is crucial for addressing soil nutrient depletion and mitigating the shortage of inorganic fertilisers caused by their high cost. This approach can ultimately enhance the quality of fruits and vegetables and reduce production costs [5].

These challenges must be promptly addressed by improving cultivation practices through the application of solid and liquid organic fertilizers [6]. Nutrient management through fertilisation is crucial for optimising plant growth and yield [7]. Ref. [8] further adds that successful fertilization enhances nutrient uptake by plants, thereby addressing nutrient deficiencies.

Liquid organic fertilizer can be produced by utilizing natural organic materials rich in nutrients that are beneficial for plant growth and development. Readily available local resources can be used for its production. These include banana stems, coconut husks, sintrong leaves (Crassocephalum crepidioides), and layer chicken manure, which serve as sources of macro and micronutrients, as well as various organic matter. Additional components such as cow urine, coconut water, and rice-washing water—often discarded as waste—can be incorporated as sources of vitamins, minerals, and natural growth regulators [9; 10].

Farmers have traditionally considered cattle urine a waste product; however, it holds significant potential for use as a liquid organic fertilizer. This is due to its higher content of nitrogen, phosphorus, potassium, and water compared to solid cattle manure. When processed into liquid fertilizer, cattle urine contains substantial levels of essential nutrients that are highly beneficial for plant fertility. It functions to stimulate the growth of roots, leaves, and fruits, acts as a plant growth regulator, and enhances soil microbial activity, thereby improving harvest quality. Furthermore, the distinct odor of cattle urine serves as a botanical pesticide, repelling various plant pests, which contributes to environmental sustainability [11]. In addition to containing natural growth stimulants that function as plant growth regulators, the characteristic smell of the urine helps repel various pests, positioning it as an effective botanical pesticide. The recommended application method for this liquid cattle urine fertiliser is to dilute 10 mL of the concentrate in 1 litre of water and spray it onto all parts of the plant, particularly the underside of the leaves, on a weekly basis [12].

The Dharma Kriya farmers' group will be guided in producing both solid and liquid organic fertilisers from various organic materials that are currently regarded as waste. These materials are, in fact, suitable feedstocks for organic fertiliser production, as they contain essential nutrients for plant growth and development. This approach is particularly well-suited for developing healthy organic farming practices for Kintamani Siam citrus, addressing plant nutrient deficiencies caused by the high cost and market scarcity of conventional fertilizers.

Furthermore, the Women Farmers' Group will receive training on producing compost from household waste, including ceremonial offerings (such as janur palm leaves, various wet and dry leaves) and kitchen vegetable scraps. This initiative aims to reduce environmental pollution around homes while providing a resource to enhance soil fertility for garden plants, including ornamentals and medicinal herbs used at home.

2. MATERIALS AND METHODS

The community service activity, which focused on converting organic waste into solid and liquid fertilisers, was conducted on Sunday, June 21, 2025, at the farm belonging to the head of the farmers' group in Belantih Village, Kintamani District, Bangli Regency. The training commenced at 09:00 Central Indonesian Time (WITA) and continued until completion. The Dharma Kriya Farmers' Group and the Widya Pertiwi Women Farmers' Group were selected as participants for this initiative, with the expectation that they would acquire and apply the knowledge provided to further develop the use of organic fertilizers produced independently from locally available waste materials, which had previously been considered disposable. These waste materials included coffee husks, banana stems, livestock manure, and sintrong leaves (Crassocephalum crepidioides), which are commonly treated as weeds in citrus gardens. This program adopted an exploratory qualitative approach, implemented through the following stages: 1) Observation, aimed at assessing the conditions and potential of the farms in Belantih Village,

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Kintamani, Bangli, and identifying existing challenges; 2) Socialization, intended to provide an understanding of the benefits and functions of organic fertilizers for citrus, coffee, and vegetable crops cultivated through intercropping systems, as well as to outline the types and objectives of the activities; 3) Product introduction, focused on presenting innovations in converting organic waste into fertilizer, including the materials required and utilized; 4) Training implementation, designed to enable participants to produce organic fertilizer products following established procedures; and 5) Product evaluation, conducted to assess the quality of the previously produced organic fertilizers, identify their strengths and weaknesses, and develop solutions to address any deficiencies, ultimately resulting in a ready-to-use product.

3. RESULT AND DISCUSSION

The outcomes achieved through this community service initiative demonstrated that the Dharma Kriya Farmers' Group and the Widya Pertiwi Women Farmers' Group exhibited strong interest and high enthusiasm in participating in the training and hands-on practice sessions for converting organic waste into solid and liquid fertilizers. Through structured education and mentoring, this engagement is anticipated to enhance their technical skills, thereby improving the productivity and quality of their primary citrus crops, as well as companion coffee and vegetable crops cultivated under an intercropping system.

The educational program was delivered through two primary approaches: An instructional seminar on processing technologies for converting various types of organic waste into solid and liquid fertilizer products, and Practical, hands-on training sessions. The implementation of the service activity adhered to the predefined methodological framework, which consisted of the following stages: 1) Observation and Identification, 2) Socialization of the benefits and objectives of waste processing and utilization, 3) Introduction and explanation of innovative organic waste processing techniques, 4) Training on the production of solid and liquid organic fertilizers, and 5) Program evaluation.

The initial phase of the activity commenced with observation and identification, conducted at the outset of the community service program. This involved surveying and gathering information regarding the village's potential and local farming systems. Additionally, the team identified existing challenges and necessary innovations to develop the village's agricultural capabilities further. Based on the observational findings, several key issues commonly faced by the community were identified: Citrus cultivation and agribusiness have not yet significantly improved farmers' welfare, primarily due to the persistently low quality of citrus produce. This problem stems from farmers' limited knowledge of adopting improved cultivation technologies, particularly regarding balanced fertilisation practices essential for high-quality yields.

Furthermore, the high cost and occasional market unavailability of inorganic fertilizers compel farmers to rely solely on livestock manure (from poultry or cattle). This manure is often inadequately composted, leading to environmental concerns such as unpleasant odors, fly infestations, and increased fungal incidence in crops. Conversely, abundant organic materials—currently treated as waste—remain underutilized. These include scattered coffee husks in plantations, citrus fruit dropped or rotten due to fruit fly infestations, banana stems (commonly grown as garden fences), and sintrong leaves (Crassocephalum crepidioides), which are often regarded as weeds in citrus groves.

Based on the observational findings, it can be concluded that the identified problems include a lack of development and innovation in processing waste into organic fertilizer as a form of renewable product. Furthermore, there is a lack of education regarding the treatment of materials currently regarded as waste. These materials have the potential to be processed into high-quality fertilisers, which could be used to enhance soil fertility. This is particularly relevant, as the excessive use of inorganic fertilisers has led to soil degradation. The results of the field observation in Belantih Village, Kintamani District, Bangli, are presented in Figure 3.

Fig. 3. Results of garden observation activities in Belantih Village, Kintamani District, Bangli a) Coffee skin waste scattered in the garden, b) Lots of banana stem waste in the garden because it is used as a garden fence, c) Sintrong plants have been considered weeds in citrus plantations.

The second stage involved outreach focused on training for the processing and utilisation of discarded organic waste into a liquid fertiliser. This socialization activity was conducted to educate participants on the comprehensive benefits and efficacy of the resulting fertilizer, as well as its entrepreneurial potential. The initiative aimed to promote a shift in community mindset towards the use of organic fertilizers to achieve high-quality, safe-to-consume agricultural products. The outreach session on processing and utilising waste for liquid organic fertiliser production is illustrated in Figure 4.

Fig. 4. Socialization regarding the processing and utilization of waste into liquid organic fertilizer and the materials used.

The third stage involved an introductory session on the materials and equipment required for processing organic waste, along with the procedural steps. This activity aimed to empower the community by providing knowledge on converting organic waste into an innovative liquid organic fertiliser product, offering direct benefits to farmers. The processing steps for transforming organic waste into liquid organic fertilizer are as follows: 1) Shredding raw materials using a mechanical shredder. Materials processed included sintrong leaves (Crassocephalum crepidioides), banana stems, citrus waste, and lemongrass stalks and leaves. 2) Preparing a fermenter solution (e.g., Biomol, Biome, or Agrodyke). 3) Mixing components: Combining cow

urine and manure in a 150-liter drum, adding the fermenter solution and shredded materials, followed by thorough stirring to ensure homogeneity. 4) Sealing the drum tightly after mixing.5) Fermenting the mixture for one month in a cool area away from direct sunlight, with weekly stirring. 6) Filtering and packaging: After fermentation, the liquid organic fertilizer was filtered and transferred to airtight storage containers.

The introduction to waste processing innovation, including explanations of necessary tools, materials, and procedures, is presented in Figure 5. The final liquid fertilizer product and its packaging method (e.g., jerricans and storage bottles) are shown in Figure 6.

Fig. 5. Introduction to waste processing innovation and explanation of the tools and materials required and processing procedures.

Fig. 6. Results of liquid fertilizer products and how to store them in jerry cans and storage bottles

The evaluation of the mentoring program's success, measured by participant enthusiasm, yielded highly satisfactory and encouraging results. Qualitatively, this was reflected in their strong motivation and diligent engagement during the hands-on practice sessions. Throughout the practical activities, participants actively discussed various issues related to the challenges they encounter in their farming practices. To quantitatively assess the effectiveness of the extension activities, an evaluation was conducted using a distributed questionnaire. The results demonstrated a significant improvement in overall knowledge, with 95% of respondents reporting a comprehensive understanding, while the remaining 5% indicated a good grasp of the presented material and methods for processing organic waste into solid and liquid fertiliser products. Notably, no respondents reported a lack of understanding or poor comprehension. This suggests that farmers can independently utilise these techniques to reduce their dependence on commercial inorganic fertilisers. Among the 20 participants, 80% expressed high satisfaction with the training, and the remaining 20% reported satisfaction with their involvement in the extension activities. Furthermore, 80% of respondents indicated a strong interest, and 20% expressed interest in implementing organic waste processing techniques to produce fertiliser at their own homes. These findings confirm that 100% of participants—both from the farmers' and women farmers' groups—are keen to enhance their skills and adopt waste-processing technologies to produce valuable fertilizer, thereby reducing production costs

4. CONCLUSION

Based on the community service activities conducted, it can be concluded that: (1) The education and training on processing organic waste into liquid organic fertilizer proceeded smoothly and as planned; (2) There was an overall increase in knowledge, with 95% of respondents indicating a thorough understanding and the remaining 5% indicating a good grasp of the material and methods presented. This signifies that no respondents reported a lack of understanding or poor comprehension. Among the 20 participants, 80% expressed high satisfaction, while the remaining 20% reported satisfaction with their involvement in the extension activities. All participants demonstrated an interest in applying waste processing techniques to produce fertiliser independently. These results indicate that 100% of the farmers' and women farmers' group members are keen to enhance their skills and adopt waste-processing technology to produce organic fertilizer, thereby improving the productivity and quality of citrus and intercropped coffee plants.

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