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Enhancing the Value of Coffee Husks as Organic Fertilizer in Windu Sari Farmer Group, Batukaang Village, Kintamani Bangli

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ABSTRACT

Coffee Husks produced from coffee processing are waste that can be used as raw material for making organic fertilizer. Utilizing coffee Husks as organic fertilizer can increase added value and farmers' income while reducing the smell from piles of coffee Husk waste, which can pollute the environment. Development efforts to overcome this problem include processing coffee Husk waste into compost. In this service activity, partners will be introduced to and trained in the technology for making quality compost fertilizer and managing coffee farming businesses to provide added value and improve the farmer's economy. This service aims to increase the added value (value added) of coffee Husk waste as organic fertilizer in the Windu Sari Farming Group. The problems found in farmer groups are the problem of piles of coffee husk waste, which have not been appropriately handled, and the problem of technology for making compost fertilizer, which has not been fully understood by partners, as well as farming business management problems related to group strengthening. The method used in community service in Batukaang Village is the Participatory Action and Learning System (PALS). This method aims to make the partner group an object in service activities through various forms such as education, training, counseling, as well as coaching and mentoring. The PALS method is implemented in several stages: (1) awareness phase, (2) capacity building phase, mentoring phase, and (3) institutionalization phase. The results obtained from this service program are in the form of a technology package for making compost fertilizer. From the service that has been carried out in the form of counseling, training, and the practice of making organic fertilizer compost, the response from the community, in this case, the Windu Sari Farmers Group, has been excellent. The participants' enthusiasm was seen from the many questions submitted to the service team regarding compost-making technology and its benefits for agriculture.

1. INTRODUCTION

1.1. Background

Batukaang is a cultural tourism village about 60 km from Denpasar, 35 km from Bangli City, and 18 km from the sub-district capital. Located at 1,200 meters above sea level (ASL), it's one of 12 villages in Kintamani District. The village's residents primarily engage in agriculture and plantation-related livelihoods. One recurring challenge in the community relates to limited employment opportunities that align with the region's development level, as outlined in the Bangli Regency regional development plan.

Despite the gradual decrease in the poverty rate in Batukaang Village, there remains a need to explore additional opportunities for enhancing the community's economic well-being. Farmer groups serve as valuable assets in conveying information during the village development process. Notably, even in the era of the COVID-19 pandemic, the agricultural sector remains the cornerstone of livelihood for the majority of the Batukaang village community. Agricultural and plantation products like Arabica coffee and Kintamani oranges are the cornerstones of their farming activities. Kintamani coffee has gained international

recognition for its distinctive flavor, featuring aromatic spice notes. It has been registered as a geographical indication product, which offers protection and utilization benefits.

Coffee represents a significant potential plantation crop in Bali Province. The Kintamani District stands out as the largest coffee-producing district within Bangli. In this district, there are various "Abian Subak" members engaged in Arabica coffee cultivation and both wet and dry coffee processing. The Kintamani District's specific geographic characteristics make it well-suited for coffee plant growth, with altitudes ranging from 900 to 1,600 meters above sea level, meeting the ideal conditions for coffee plant cultivation.

In Kintamani, the total plantation area spans 8,949 hectares, with 5,656 hectares dedicated to coffee cultivation. The remaining land is utilized for growing cloves, coconut, and cocoa, making it a diverse agricultural area. However, the ongoing challenge in Indonesia's coffee production lies in the relatively low quality of the coffee beans, which subsequently impacts the final coffee production. It's important to note that the coffee processing methods, either wet or dry, significantly influence the quality and flavor of the coffee [1], [2].

The primary distinction between these two methods lies in the timing of peeling the fruit pulp, horn Husk, and epidermis. In dry processing, this peeling occurs after the coffee has dried, resulting in what's known as "coffee logs." Conversely, in wet processing, the peeling happens while the coffee is still wet.

Stable and consistent price developments are of great importance to coffee farmers as they play a crucial role in ensuring the sustainability of their farming practices. Despite the focus on sustainable coffee farming, much coffee husk waste is generated during coffee processing. Unfortunately, this waste hasn't been fully harnessed to enhance the economic value of coffee products. Although the prices of Arabica coffee at the farmer level in Bali have been increasing in alignment with international market trends, there's still work to be done in creating activities that can add further value to the coffee industry [3], [4], [5].

After the coffee harvest, there is as much as 50% coffee husk, a by-product that can offer additional value. If not appropriately managed, this by-product can potentially contribute to environmental issues [6], [7]. The coffee husk, rind, and coffee grounds collectively contain approximately 45% cherries. These components are among the primary by-products of the coffee agroindustry, and they are valuable materials suitable for various purposes, including the extraction of caffeine and polyphenols [8]. During the coffee processing in Batukaang Village, nearly 50% of coffee Husk waste is generated. This processing typically results in the production of 46-56% coffee Husk waste that can still be put to good use [9].

Coffee fruit Husk is rich in nutrients, containing approximately 1.27% nitrogen, 0.06% phosphorus, and 2.46% potassium [10]. Whether it's produced through wet or dry processing, coffee Husk waste maintains a relatively high nutritional content. Dried coffee Husk comprises 58-85% carbohydrates, 8-11% protein, 0.5-3% fat, and 3-7% minerals [11]. Coffee Husks include carbohydrates like fermentable sugars, polyphenols such as tannins and lipids, and various microorganisms, including fungi, that thrive on coffee Husk waste despite antimicrobial compounds [12]. Coffee Husk offers excellent potential as a substrate for value-added compounds [13].

The processing of coffee cherries results in abundant coffee husk waste, accounting for about 50% of the waste generated. This waste can be repurposed as organic fertilizer, and composting it can have a beneficial impact on supplying nutrients to the soil, especially after application, through the weathering process. This process positively affects biomass production [14].

Given the substantial potential of the waste and the nutrient-rich content of coffee Husk waste, there is an opportunity to use this waste as the primary raw material for creating organic fertilizer, which can add economic value for coffee farmers in Batukaang, Kintamani, Bangli village.

Batukaang Village boasts significant potential, encompassing natural resources, human resources, and various institutions and organizations. However, these resources have yet to be fully harnessed. Notably, the agricultural sector in Batukaang Village stands out due to favorable climate conditions and fertile soil. Coffee and orange plants are the primary crops cultivated in this village. Unfortunately, coffee Husk waste is often discarded directly onto garden land without undergoing a fermentation process, leading to its accumulation and environmental pollution.

The opportunity and potential of this abundant waste from coffee Husks can be unlocked by converting it into organic fertilizer, which enhances soil fertility. Producing organic fertilizer through straightforward composting techniques can be conducted by community partners until the product is packaged and ready for market. This endeavor not only increases group income but also adds value to coffee Husks by transforming them into an environmentally friendly product with economic significance.

Compost fertilizer is an organic product created through the fermentation of coffee Husk waste. In addition to coffee Husk waste, the process involves using other materials like leaves and twigs from pruned coffee trees, agricultural waste, livestock waste, biochar, kitchen ash, bran, and dolomite. Through participation in community service programs, the goal is to address the issue of coffee Husk waste and develop a solution for transforming this waste into organic compost fertilizer. This approach is expected to generate economic value and benefits for the coffee industry, particularly benefiting coffee farmers in Batukaang Kintamani Village, Bangli.

1.2. Objective

The purpose of this zction research is to 1) Raise awareness among the group about the added value of coffee Husks as an environmentally friendly organic fertilizer. 2) Transfer technology for coffee Husk composting into organic fertilizer to enhance the understanding and skills of partner groups. 3) Strengthen partner groups through business management training.

2. MATERIALS AND METHODS

Community service was conducted at the Windu Sari Farmers Group in Batukaang Village, Kintamani District, Bangli Regency, Bali Province, at 1,200 meters above sea level.

The service activities in Batukaang Village utilize the Participatory Action and Learning System (PALS) method. This method involves making the partner group an active part of the service process through various means, including education, training, counseling, coaching, and mentoring [15]. The PALS

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method is structured into several phases, including awareness, capacity building, scaffolding, and institutionalization [16].

Technology transfer is a key component of this service. Therefore, participants in the program are expected to be well-prepared. It is hoped that by the end of this activity, participants will have the skills to produce organic fertilizer using the correct procedures independently.

3. RESULT AND DISCUSSION

3.1. Technology Transfer for Coffee Husk Composting

This activity focused on introducing and practicing converting coffee husk waste into organic compost fertilizer. It took place at the Windu Sari Farmers Group location in Batukaang Village and involved 20 participants, including 6 students from the Master of Agricultural Science Postgraduate Program at Warmadewa University. During this session, participants received informative leaflets on compost-making materials. The technology transfer for producing organic compost fertilizer from coffee husks proceeded as planned, and participants successfully learned and applied the compost-making process (Figure 1). Here are the steps involved in creating organic fertilizer [17], [18]:

Materials and Tools: You'll need coffee husks, plant trimmings, manure, fine bran, dolomite, Effective Microorganisms (EM4), and molasses. Additionally, gather tools like scales, a measuring cup, a bucket, a hoe, a rake, a sprayer, and a tarpaulin.

Composting Process for 100 kg: Begin by spreading 60 kilograms of coffee pods from local farmers onto a tarpaulin. Add 25 kg of manure and 10 kg of chopped coffee trimming waste, and evenly sprinkle 5 kg of fine bran and 2 kilograms of dolomite. Afterward, pour a mixture of 100 ml of EM4 and 100 ml of molasses dissolved in 10 liters of water until the moisture content reaches 40% (when you clench your fist, it shouldn't release water, and when you open your fist, the compost medium should not be crushed or release water). Cover the material tightly with a tarp.

During Composting, The temperature within the tarpaulin will rise to approximately 50°C and then drop again. Once a week, turn over the material inside the tarp, and if it becomes too dry, add some water.

Maturation: After 2-3 months, the compost will mature. You'll recognize mature compost's lack of odor, dryness, dark brown color, and crumbly texture. Once the composting process is complete, reduce its size and sift it to obtain a consistent texture.

Packaging and Application: The compost is ready to be packaged and used as a planting medium.

3.2. Economic and Social Impact

The technology transfer for producing organic fertilizers through a simple composting process has successfully enhanced the knowledge and skills of our partners. They've learned to transform coffee husk waste into organic fertilizer, which not only improves soil fertility and crop yields but also adds value to partner groups [19], [20]. We've also facilitated knowledge transfer through group strengthening and coffee business management. This includes mentoring, counseling, training, and practical sessions on organic fertilizer production, integrated into the activities of the Windu Sari Farmer Group in Batukaang Village, Kintamani District. The resulting organic fertilizer products are now ready for market use, aiming to enhance agricultural production and farmers' income.

Figure 1. The practice of technology transfer for making compost made from coffee husk waste

We've also shared the technology transfer process with partner group participants through various online media platforms, including Kabaribali, Balinese Dewata News, and YouTube videos of community service activities. As part of the training, we've provided participants with informative leaflets.

The technology transfer process has gone according to plan, with partner farmers successfully adopting the technology for organic fertilizer production. We've introduced an innovative approach for utilizing coffee husk waste by converting it into organic compost. Through this technology transfer, we hope to see the abundant coffee husk waste in our partner groups transformed into organic fertilizer, contributing to business development and increasing the economic well-being of the Batukaang village community.

You can find documentation of the management service activities for processing coffee husks into organic fertilizer in Batukaang Village, Kintamani District, in Figures 2 and 3.

3.3. Partner Contributions to Implementation

Our service partners played a significant role in facilitating the process of making organic compost from coffee husk waste in the Windu Sari Farmer Group, Batukaang Village, Kintamani District. Apart from providing training, technology transfer practices, and mentoring, they also contributed by giving leaf and twig chopping machines. These environmentally friendly tools enable farmers to produce organic fertilizer from various agricultural wastes sustainably, ultimately increasing their income. As a result of this community service activity, farmer groups have become more motivated and enthusiastic about enhancing the natural resources around them, adding value to their practices, and boosting their income.

3.4. Inhibiting and Supporting Factors

Technology transfer takes time and often involves changing established farming practices. However, continuous assistance from the service team is expected to lead to positive changes in farmer behavior and, ultimately, improved income. The Windu Sari Farmer's Group in Batukaang Village has shown openness to change, mainly when it contributes to the group's progress. Their positive response during this community service activity shows their potential in utilizing natural resources, including coffee husk waste and agricultural land, to increase soil fertility through organic fertilizer.

Figure 2. Providing education on composting technology and its benefits for agriculture and the environment

Figure 3. Photo with the Windu Sari farmer group

3.5. Solution and follow-up

In this community service activity, we introduced and practiced producing organic fertilizer using simple fermentation technology. We emphasized the importance of organic fertilizer in enhancing nutrient-poor soil. The farmers' enthusiastic response during the training is a testament to their willingness to embrace these practices. The solutions offered to partners address their specific challenges: 1) Increasing group awareness about the added value and economic benefits of coffee husk waste used as environmentally friendly organic fertilizer, 2) Technology transfer for composting coffee husk waste into organic fertilizer to enhance understanding and skills, allowing partners to produce and package compost organic fertilizer, and 3) Strengthening partner groups through business management training to enable them to manage organic fertilizer businesses within the group. Community service activities aimed at making organic fertilizers have been well-received by training participants, fostering hope that organic fertilizer (compost) produced by partner groups will enhance soil fertility, agricultural productivity, and farmers' income.

3.6. Plans, Strategic Steps, and Further Realization

Based on the results, we plan to offer ongoing program assistance through monitoring and evaluating the technology transfer practiced by partner groups. Through continuous monitoring and evaluation, we aim to enhance further the skills and motivation of partner groups in producing organic compost fertilizers while efficiently utilizing the abundant coffee husk waste surrounding coffee processing plants.

Our first strategic step is to maintain the substantial cooperation established with the Windu Sari farmer group to ensure the sustainable production of organic compost fertilizers. The second strategic step involves garnering support from local governments, communities, entrepreneurs, and agricultural stakeholders to utilize agrarian waste effectively for the production of environmentally friendly organic fertilizers, promoting sustainable agriculture.

4. CONCLUSION

Community service activities, including training, technology transfer, and mentoring, have empowered farmer groups to produce organic fertilizer from coffee husk waste. These farmer groups have displayed motivation and competence in applying technology transfer to produce market-ready organic fertilizers, enhancing soil fertility and agricultural production. The organic fertilizer products, sourced from coffee husk waste, hold the potential for use by local governments, agricultural stakeholders, and fertilizer manufacturers, contributing to developing eco-friendly and sustainable organic fertilizer products.

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