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Optimizing the Value of Goat Manure as Organic Fertilizer Through Anaerobic Processing and Enhanced E-Commerce Marketing

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Abstract Dairy goat farming is a livestock system in which all goat-derived products, including milk, meat, urine, and feces, can be utilized. At Pure Fresh Dairy Farm, more than 120 dairy goats produced a significant amount of milk. However, the large goat population also generated substantial amounts of feces. Prior to this initiative, there had been no utilization or processing of goat feces using anaerobic technology to produce organic fertilizer or generate additional farm income. This community service program aimed to provide knowledge and training to Pure Fresh on producing organic fertilizer from dairy goat feces using the anaerobic method and enhancing its market value through e-commerce. The organic fertilizer was produced using dairy goat feces combined with dolomite lime, molasses, and EM4. The addition of these components accelerated the fermentation process, enhanced efficiency, and resulted in a higher-quality fertilizer with a more balanced nutrient composition, thereby improving soil conditions. The fertilizer products were marketed to supplement Pure Fresh's income, while a portion was allocated for community agricultural use. The final product was packaged in transparent plastic bags weighing 2 kg, branded as 'PO-GOAT'. The initial production yielded 54 kg, which was sold at IDR10,000 per 2 kg and was planned to be marketed through e-commerce.

1. INTRODUCTION

Although Indonesia has fewer goat farms than dairy farms, the number of dairy goat farmers has been increasing. Goats are relatively easy to raise, as they adapt well to changing climate and environmental conditions and consume a diverse range of plants. Among the most commonly bred goats for milk production are Saanen, Etawa, and Alpine goats. Pure Fresh Dairy Farm is one of the dairy goat farms in Petir Village, downstream Ciamis, West Java, housing approximately 120 dairy goats. In addition to meat, goats provide other high-value products, including nutritious goat milk, textile-grade goat hair, and, notably, goat feces. Due to the large population of dairy goats, Pure Fresh generates a significant amount of feces. However, farmers have not utilized goat feces to enhance their economic value. Unprocessed goat feces in dairy goat farming poses serious challenges, affecting livestock health, environmental quality, and overall production efficiency. Goat feces contain bacteria and parasites that can transmit diseases, such as worm infections, diarrhea, and other zoonotic diseases that may impact both humans and animals (Arsenopoulos et al., 2021; Mammeri et al., 2020). At Pure Fresh, goat feces are directly put in sacks and traded without any processing. As a result, the nutrient content and selling value of the fertilizer are still low. In addition to the

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incompletely decomposed feces still undergoing active decomposition process (Krueger et al., 2021). This process produces heat that can damage or burn plant roots, so plants can die or experience poor growth. Therefore, there needs to be a new innovation that is more effective and efficient in the utilization of goat feces at Pure Fresh.

Goats are popular small livestock that produce dung, which can be used as manure to improve soil quality (Katakula et al., 2021). Processing dairy goat feces with anaerobic methods is a program provided by the service team to partners, namely pure fresh, to increase the selling value and nutritional value of fertilizer from dairy goat feces. Processing organic fertilizer from goat feces is a method of decomposing organic matter by microorganisms in conditions without oxygen (Nag et al., 2019; Orangun et al., 2021). Anaerobic microorganisms break down the complex organic matter in goat feces into simpler compounds, resulting in nutrient-rich organic fertilizer and biogas gas that can be used for energy (Rana & Roy, 2024). This process aims to improve the quality and availability of nutrients in goat feces to make it more optimal as fertilizer. The addition of EM4 also helps speed up the fermentation process in making organic fertilizer (Katakula et al., 2021). It contains microorganisms that help accelerate the decomposition process of organic matter in goat feces. With the addition of EM4, goat feces can be converted into organic fertilizer more quickly using an efficient anaerobic process. While livestock waste-based organic fertilizers offer significant market opportunities driven by sustainability trends and growing organic agriculture, they also face barriers related to perception, quality consistency, regulatory challenges, and market competition. Addressing these barriers through technology, education, and strategic partnerships can help unlock their full potential in the marketplace.

The purpose of this community service was to provide knowledge and training to Pure Fresh in making organic fertilizer from dairy goat feces using the anaerobic method and increasing the use value of fertilizer through e-commerce.

2. METHOD

2.1 Materials

The materials used in the production of organic fertilizer from dairy goat feces comprised goat feces, dolomite lime, molasses, EM4, buckets, sacks, water, a spray tank, a vacuum sealer, rope, and a feces grinder. The selected feces met the criteria of being uncontaminated, meaning they were not mixed with urine or other chemical substances.

2.2 Dissemination and activity briefing

Prior to the training on organic fertilizer production, a pretest was conducted to assess the farmers' initial knowledge levels at Pure Fresh and its partner farms. This was followed by dissemination and a briefing on the procedures for making organic fertilizer. A total of 20 field workers participated in this training, with an average age of 27–35 years and an average education level of senior high school. The training covered various topics, including information on organic fertilizer, the tools and materials required, and the step-by-step production process. Additionally, participants received training on effective marketing strategies for their products, particularly through e-commerce. At the conclusion of the training, a posttest was conducted to evaluate participants' progress and measure changes in knowledge before and after the community service initiative.

2.3 Manufacturing process of organic fertilizer

The manufacturing process of organic fertilizer involves several key steps to ensure nutrient-rich and eco-friendly products. Initially, raw materials (goat manure) are collected, properly sorted, aeration, mixing, grinding, spraying molasses to manure, fermentation and packaging (Figure 1).

Figure 1 . The process of producing organic fertilizer from goat feces

1. Goat feces harvesting

   Goat feces were collected using a shovel. The feces had to be dry and free from urine. Fresh goat feces were gathered from the farm or enclosure. The feces were naturally dry, pelleted, and relatively easy to handle.

2. Goat feces sorting

   The sorting process separated non-biodegradable materials such as stones, plastic, and metal to prevent contamination and maintain fertilizer quality. Sorting

ensured that only clean, processable goat feces were used, preventing contamination from chemicals, toxins, or pathogens found in mixed waste (Rana & Roy, 2024).

3. Goat feces aeration

   To maintain optimal moisture levels and achieve a suitable consistency for microbial decomposition, feces aeration was conducted. Aerobic microorganisms require oxygen to convert organic matter, including goat feces, into compost. Aeration promoted microbial activity and accelerated decomposition (Ananda et al., 2024).

4. Molasses mixing

   A mixture of water, molasses, and EM4 liquid was prepared to reduce ammonia levels in the feces. Molasses contained easily digestible sugars, which provided energy to decomposing microorganisms, thereby enhancing the breakdown of organic matter, including goat feces (Nadeeka & Seran, 2020). The mixture was left for approximately one hour before being sprayed onto the milled feces.

5. Feces grinding

   The feces were ground into a fine, coffee-like powder using a grinder similar to a rice mill.

6. Spraying molasses mixing

   The prepared molasses mixture (water, molasses, and EM4) was sprayed onto the feces using a spray tank. The spraying process was carried out in several layers to ensure even distribution of the molasses and EM4 mixture.

7. Fermentation

   The fermentation process was conducted by storing the feces in sacks under anaerobic conditions for two weeks, with checks performed every three days. The purpose of fermentation was to break down the fecal material into stable, plant-absorbable nutrients, deodorize the material, reduce temperature, eliminate harmful bacteria and pathogens, and accelerate the composting process.

8. Fertilizer Packaging

   After the successful production of organic fertilizer, it was packaged in 2 kg plastic bags and branded with a printed and vacuum-sealed "PO-GOAT" sticker.

3. RESULT AND DISCUSSION

3.1 Dissemination and mentoring

In addition to several Pure Fresh partners, over twenty farmers who were Pure Fresh employees themselves attended the dissemination and briefing on the process for creating organic fertilizer. Presentation contents utilizing Power Point and a number of supplementary graphics are used in dissemination. All of the Community Partnership Program's teams provided speakers. As they assisted with question answering and posttest questionnaire distribution. The lively questions regarding the making of organic fertilizer showed that everyone had paid attention to the briefing and did so with enthusiasm.

Pre-service dissemination was crucial in ensuring efficiency, relevance, and community engagement during the execution of service activities. Providing the community with basic information beforehand helped them become more prepared and motivated to actively participate in the community service program. Active community involvement contributed to the overall success of the program's implementation. The average pretest score of the 20 respondents (breeders) was 89%, indicating a lack of knowledge about the anaerobic method of processing goat feces into organic fertilizer. However, following the dissemination of information and training, the posttest results showed that 100% of the farmers had acquired knowledge and understanding of the anaerobic goat feces processing procedure (Table 1).

Table 1 . Pretest and posttest understanding of pure fresh farmers about making organic fertilizer from dairy goat feces

No	Indicators	% Farmer Responses			
		Pretest		Posttest	
		Yes	No	Yes	No
1	Do farmers know the definition of organic fertilizer?	10	90	100	0
2	Do farmers know the anaerobic method of fertilizer production?	0	100	100	0
3	Do farmers understand the anaerobic digestion of goat feces?	20	80	100	0
4	Do farmers know the function of EM4 and molasses in the fertilizer production process?	5	95	100	0
5	Do farmers know the function of molasses in the fertilizer production process?	5	95	100	0
6	Do farmers recognize e-commerce?	9	91	100	0
	Pretest Score Mean	**89**			
	Posttest Score Mean	**100**			

The farmers' responses shown in Table 1 demonstrate that the dissemination process was required prior to the activities being carried out (Legrain et al., 2021; Richards & Gordon, 2017).

3.2 Implementation of activities to make organic fertilizer from goat feces

The production of organic fertilizer from goat feces was carried out by Pure Fresh under the guidance and

assistance of the community service team members. Test results indicated that the organic fertilizer derived from goat manure met user standards for high-quality organic soil amendments. The organic fertilizer production began with the collection of goat feces, yielding 54 kg of sorted feces. The feces used were slightly dry rather than wet, a condition that helped reduce ammonia odor and accelerated the fermentation process. Before grinding, a sorting process was conducted to ensure that only pure goat feces, free from leaves or other contaminants, were processed. Dolomite lime was added to further reduce odor. As a source of calcium and magnesium, dolomite lime helped neutralize acidity in both the organic fertilizer and the soil (Handajaningsih et al., 2021). If feces fertilizer is too acidic, the soil may also become acidic, which will inhibit plant growth (Cameron et al., 2013). With the addition of dolomite, acidity can be reduced, making the fertilizer more friendly to soil and plants. Dolomite lime also helps improve soil structure, making it looser and improving aeration and water retention. The addition of molasses as a source of carbon and high sugar. In making organic fertilizer, molasses serves as an energy source for microorganisms (Nadeeka & Seran, 2020; Sunaryo et al., 2023). Microorganisms in organic fertilizer, especially in the fermentation process, need energy to multiply. The griding process aims to expand the surface of the feces itself to accelerate the absorption of additional molasses and EM4, in addition to accelerating the fermentation process.

Molasses accelerates the growth of good microbes that help decompose organic matter, so the fertilizer matures quickly and is rich in nutrients. EM4 contains various types of beneficial microorganisms, such as lactic acid bacteria, photosynthetic bacteria, yeast, and other microorganisms. These microorganisms play an important role in accelerating the decomposition process of organic matter. EM4 increases the content of beneficial microbes in organic fertilizer, which helps accelerate the decomposition of goat feces, makes the fertilizer faster, and improves the quality of the fertilizer. In addition, EM4 can help reduce the odor resulting from the fermentation process, which is often a problem in making fertilizer from organic materials such as feces. With the addition of dolomite lime, molasses, and EM4, the process of making organic fertilizer from dairy goat feces not only becomes faster and more efficient but also produces higher-quality fertilizer with a more balanced nutrient content and improves soil conditions (Pancapalaga et al., 2021). Molasses is an excellent source of energy for various forms of microorganism life. Molasses is a source of carbohydrates that stimulate the growth of beneficial microorganisms. A good type of molasses for fertilizer is blackstrap (unsulfured) molasses because it has the highest concentration of sulfur, potassium, iron, and other micronutrients of real sugarcane, so it is not only the sugar content that makes molasses useful but also the mineral content in it. Molasses is an excellent chelating agent, which means it can help convert some chemical nutrients into a form that is easily available to microorganisms. The dose of molasses used in making organic fertilizer with a total amount of 100 kg of fertilizer is 100 ml (Nurtjahyani et al., 2020). Feces that have been completely destroyed in the form of fine granules, black in color, and smelling of soil indicate that the fertilizer is ready to be harvested. Fertilizer that is marked by black discoloration and no odor indicates that the composting has been successful (Saputra et al., 2023).

3.3 Packaging of organic fertilizer from goat feces and product branding

The finished fertilizer was packaged in 2 kg sacks and sealed using a vacuum sealer. As part of this community service initiative, a brand identity was developed to enhance the product's market value. The team named the product 'PO-GOAT', representing organic fertilizer derived from dairy goat feces (Figure 2). The organic fertilizer was marketed through e-commerce platforms, including Shopee and Instagram, as well as through direct sales at livestock festival events. The team conducted marketing training and practical sessions, which included instruction on creating e-commerce accounts (Shopee and Instagram) and utilizing online marketing services. The findings indicated that Shopee significantly facilitated the product marketing process. By leveraging Shopee's features and support services, farmers were able to expand their market reach, increase sales, and manage operations more effectively. Additionally, e-commerce marketing proved to be more cost-efficient compared to traditional marketing methods (Mata & Quesada, 2014). Digital advertising, social media promotions, and email campaigns are usually more cost-effective than print or television advertising (Jansen & Molina, 2006). E-commerce allows consumers to purchase products anytime and from anywhere. This increases customer convenience and satisfaction, which can increase sales conversion rates.

Figure 2 . Dairy goat feces organic fertilizer brand

3.4 Production capacity

The total production capacity successfully harvested was 54 kg, which was packaged in 2 kg plastic bags,

resulting in 27 individual packages. The fair market price for one bag of the finished fertilizer was set at 10,000 rupiahs, meaning that if all units were sold, the farmer group would generate 270,000 rupiahs per production cycle.

The potential income would increase proportionally with higher production volumes. Continuous production could be maintained without waiting for the complete decomposition of goat feces, as the fermentation process facilitated by EM4 bacteria and molasses allowed for ongoing fertilizer production.

4. CONCLUSION

Farmers' understanding of processing goat feces into organic fertilizer increased significantly following dissemination and mentoring, with 100% of participants demonstrating improved knowledge. The organic fertilizer produced from dairy goat feces yielded high-quality results, characterized by a blackish color, the absence of odor, and improved plant growth without signs of yellowing or wilting. The final product was marketed through e-commerce platforms, specifically Shopee, under the brand name 'PO-GOAT'. The dissemination and training activities on organic fertilizer production from goat manure had a significant impact on Pure Fresh farms, notably by enhancing farmers' knowledge and skills in organic fertilizer production and improving their ability to utilize technology for product marketing.

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CONFLICT OF INTERESTS

The authors declare that there are conflict of interests.

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