

Empowering Farmers through Fine Crumble Organic Fertilizer Innovation for Sustainable and Eco-Friendly Agriculture

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Abstrak

Munggang Wetan Hamlet, Sidoharjo Village, Samigaluh District, Kulon Progo, is in the Menoreh Highhills region, which has great goat farming potential. The KUBE Sejahtera X Binangun 005 farm groups has been using goat manure as organic fertilizer; however, they continue to encounter challenges due to its rough texture and basic packaging. This community service activity aims to improve and enhance the quality of organic fertilizer products through the application of Compost Maturation Technology and the use of a compost grinding machine to produce fine crumble organic fertilizer. The activity was conducted using a participatory approach that included outreach, training, technology application, and evaluation. The results of this community service activity showed a significant improvement in the physical quality of organic fertilizer that meets SNI standards, with characteristics such as a crumbly texture, blackish-brown color, a humus-like odor, and a temperature of 30–35°C, making it suitable for agricultural use. Additionally, the innovative packaging design has the potential to enhance the sales value of the partner group's organic fertilizer products. This activity not only supports local economic potential but also reinforces the principles of sustainable agriculture by utilizing livestock manure as a productive resource. This program is expected to become a model for rural community empowerment based on appropriate and environmentally friendly technology.

Abstract

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INTRODUCTION

Munggang Wetan Hamlet, located in Sidoharjo Village within the Samigaluh District of Kulon Progo Regency, is part of the Menoreh Highhills. This region boasts significant agricultural and livestock potential, with the economy largely dependent

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on the livestock sector, particularly goat farming. One active community group is the KUBE Sejahtera X Binangun 005 Group, established in 2010 and currently comprising 30 members, as well as a population of 96 goats. Goat farming was chosen because it suits the geographical conditions and hilly topography, where land is relatively limited but forage is abundant. Furthermore, goats are easier to raise than cattle due to their lower feed requirements and high adaptability. (Handiwirawan *et al.*, 2019). Initial observations indicate that the partner group has implemented simple innovations in utilizing livestock by-products, such as processing goat manure into organic fertilizer and converting local green fodder into feed silage (Prastowo *et al.*, 2023). This activity aligns with the trend of sustainable agriculture, which prioritizes the principles of waste reduction, resource efficiency, and the reuse of by-products (Filman *et al.*, 2011). The resulting organic fertilizer still has quality issues, particularly its rough texture, which makes it less appealing to consumers. This texture is likely due to the raw material used, which is goat manure. Goat manure has a naturally granular shape that is difficult to decompose completely. As a result, the complex, granular structure interferes with the decomposition process, preventing it from breaking down entirely and disrupting the nutrient supply when applied as fertilizer (Sugito *et al.*, 2024). Furthermore, the product's simple packaging makes its selling price relatively low, and it is less competitive than commercial organic fertilizers on the market. Information technology is also not widely understood by partner groups. Low digital literacy in accessing information related to activities that support livestock farming, particularly in identifying appropriate technology for managing and processing livestock waste, is an obstacle to independently evaluating partner groups' organic fertilizer products. In the current era of agricultural digitalization, livestock breeders and farmers are required to utilize information technology as a means of expanding information about their activities, which can support economic progress (FAO, 2020). This community service activity focuses on enhancing goat manure-based organic fertilizer by improving its quality, particularly through a finer texture achieved using compost maturation technology and a compost grinding machine. Furthermore, the packaging of the final product has been enhanced to meet market standards, thereby increasing its market potential. This activity follows up on a previous community service initiative in 2023, which introduced partner groups to basic silage and organic fertilizer processing technologies. Currently, the program is primarily focused on enhancing product quality and packaging. This approach aligns with the concept of continuous community empowerment in community service, which emphasizes the importance of program sustainability and gradual community capacity building (Slamet, 2014). The novelty of this community service activity lies in two main aspects. First, it involves the use of appropriate technology, combining compost maturation with a compost grinding machine, which produces a fine-textured organic fertilizer (fine crumbler organic fertilizer) that is more marketable. Second, the project focuses on enhancing the quality of packaging to boost the economic value of the resulting fertilizer product. This approach not only aims to improve product quality but also strengthens the competitiveness of partner groups in developing a sustainable rural economy. From a sustainability perspective, the development of organic fertilizer has a dual impact. Agronomically, organic fertilizer increases soil fertility by enhancing the physical, chemical, and biological properties of the soil (Sutanto, 2002). Meanwhile, from an environmental perspective, the use of goat manure as organic fertilizer can reduce the potential for environmental pollution due to the accumulation of livestock waste, while also supporting the concept of a circular economy in the agricultural sector (EC, 2020). From an economic perspective, processing livestock waste into valuable products presents opportunities to increase the incomes of livestock farmers. Aligns with a study by (Simatupang *et al.*, 2019), which found that the majority of farmers recognize the economic and technical benefits of using organic fertilizer in their agricultural practices. Furthermore, this community service initiative aligns with the principles of Education for Sustainable Development (ESD), which emphasizes enhancing community awareness in economic, social, and environmental dimensions (UNESCO, 2017). By enhancing community knowledge regarding fertilizer processing technology, packaging, and sustainable resource management, this community service program aims to strengthen the capacity of village communities to tackle development challenges in the livestock and agricultural sectors. Based on considerations of partner conditions, local resource potential, and existing challenges, this community service activity has high relevance both academically and practically. From an academic perspective, this activity provides a platform for applying research results and appropriate technology in a real-world context. From a practical perspective, this activity is able to provide real solutions

for livestock farming groups in increasing the productivity, quality, and competitiveness of their products. Thus, this program is expected to provide sustainable benefits for the KUBE Sejahtera X Binangun 005 group and the wider Munggang Wetan Hamlet community.

METHOD

Time and location of community service activities

Community service activities were carried out in July - September 2025 at the KUBE Sejahtera X Binangun 005 Group, Munggang Wetan Hamlet, Sidoharjo Village, Samigaluh District, Kulon Progo Regency, D.I. Yogyakarta. This area is part of the Menoreh high hills region, characterized by hilly geographical features and dominant agricultural and goat farming activities. The activity had 30 group members, all of whom are actively involved in goat farming.

Problem analysis and solutions

The situation analysis was conducted through field surveys, interviews with group leaders, and direct observation of livestock farming and organic fertilizer processing activities. The analysis revealed several key issues, including the rough and inconsistent quality of the organic fertilizer produced and unattractive product packaging. The proposed solutions include the application of compost refining technology to produce a fine crumbler organic fertilizer, supported by a compost grinding machine, the application of compost maturation methods, and redesigning product packaging to make it more attractive and competitive.

Implementation of community service activities

The implementation method refers to a participatory approach, where the partner group is actively involved in every stage of the activity, from planning, implementation, to evaluation (Ife *et al.*, 2008). This community service activity was carried out using classical extension methods, interactive discussions, and fertilizer production practices using the maturation method, as well as packaging practices.

Evaluation

The success of the activity was evaluated by administering a pre-test to participants before the counseling session and a final written post-test. The goal of this activity was to ensure that participants understood the material presented during the counseling. The evaluation of the fine crumbler organic fertilizer product was conducted based on physical parameters, following the guidelines provided by (Surya *et al.*, 2021).

RESULTS AND DISCUSSION

The implementation of community service activities in the KUBE Sejahtera X Binangun 005 Group, Munggang Wetan Hamlet, Sidoharjo Village, Samigaluh District, Kulon Progo Regency, has yielded several significant achievements in the areas of production, technology transfer, and packaging of organic fertilizer made from goat manure. This activity was carried out using a combination of extension, training, technology application, mentoring, and evaluation methods. It was oriented towards the active participation of partners, referring to the method from (Ife *et al.*, 2008). The initial stage of the community service activities involved socialization and coordination with all members of the partner group (Figure 1). The purpose of this activity was to establish a shared understanding of the goals, benefits, and implementation mechanisms of the community service program. Through face-to-face meetings and interactive discussions, group members were able to express the challenges they faced, including concerns about the quality of organic fertilizer products, which still had a rough texture, as well as issues related to the packaging of these products. This approach aligns with the principles of community-based participatory methods, emphasizing the active involvement of partners in decision-making (Minkler & Wallerstein, 2011). Interactive discussions also provide benefits in creating a sense of family between the community service team and members of the livestock group.



Figure 1. Community service team from UGM with the KUBE Sejahtera X Binangun 005 Group.

The community service team also provided a set of supporting equipment for organic fertilizer production, including a compost grinding machine, a manual seal packaging machine, and other necessary equipment (Figure 2). The distribution of this equipment aims to increase organic fertilizer production capacity, enhance production efficiency, and improve product quality, particularly in terms of physical quality. Technological support has proven to be a crucial factor in the success of livestock waste-based compost processing (Abdullah *et al.*, 2015).



Figure 2. Handover of equipment to support the production of organic fertilizer from goat manure.

Training and technology transfer were provided to partner groups, focusing on Compost Maturation Technology, biostarter production, formulation, and organic fertilizer quality control. The partner groups were trained to examine the physical quality of organic fertilizer using parameters such as color, odor, texture, and temperature as indicators of good quality. The training and technology transfer were conducted through face-to-face learning and hands-on practice, accompanied by mentoring. These methods have proven effective in improving group members' skills in organic fertilizer processing (Kusuma & Hapsari, 2024). The partner group also acquired skills in operating compost grinding machines and manual seal packaging machines, adhering to standard operating procedures while prioritizing work safety principles (Figure 3).



Figure 3. Training on operating a compost grinding machine.

The process of producing organic fertilizer from goat manure using the Compost Maturation Technology method requires several materials that are easily available around the partner group, including dolomite lime, ash, goat manure, and biostarter. The biostarter is made by mixing 200 ml of molasses, 800 ml of water, and one bottle cap of EM4/starter, then incubated for 2 x 24 hours. The production of fine crumble organic fertilizer begins by mixing 5% dolomite lime, 5% ash, fresh goat manure, and 1% biostarter. The mixture is then placed into sacks, with stirring performed once a week for aeration purposes. After 30-35 days, the organic fertilizer is ready for harvest. The organic fertilizer is then crushed using a compost grinder to obtain a fine texture, known as fine crumble organic fertilizer (Figure 4). This method was chosen based on the consideration that the raw materials for making organic fertilizer are easily available around the livestock group, and the simple manufacturing process steps make it easy for the partner group to understand and apply. Goat manure, as a raw material for producing organic fertilizer, has great potential to create high-quality organic fertilizer using specialized technology (Biostarter) (Tri Pamungkas *et al.*, 2019). The steps in making organic fertilizer from goat manure typically involve preparing the ingredients, mixing, stirring, incubating, and rotating (Fany *et al.*, 2022).



Figure 4. Stages in the Process of Making Fine Crumble Organic Fertilizer.

The evaluation of the fine crumble organic fertilizer product was conducted in the fifth week, or 35th day. The evaluation was conducted together with the partner group by observing the physical quality parameters of the organic fertilizer product. The physical quality of the fine crumble organic fertilizer product from the partner group is characterized by a blackish-brown color, a smell reminiscent of humus soil, a crumbly and soft texture, and a temperature of $\pm 30-35^{\circ}\text{C}$, as presented in Table 1. In general, the physical quality of the fine crumble organic fertilizer product from the partner group is good, indicating that it has the potential to be used as fertilizer on the partner group's plantation land and possesses commercial value. Mature organic fertilizer exhibits characteristics such as a crumbly texture, a dark brown to blackish color, and no discernible odor (Trivana *et al.*, 2017; Surya *et al.*, 2021). Failed organic fertilizer products may contain mold, maggots, and have an unpleasant odor (Surya *et al.*, 2021).

Table 1. Results of fine crumble organic fertilizer products from partner groups based on physical parameters.

Parameter	Fine crumble organic fertilizer	Standard	Reference
Colour	dark brown to blackish	brown to dark brown or dark brown to blackish	Syahri & Winarsih (2022)
Texture	crumbly & smooth	crumbly, friable or smooth	Mashudi et al. (2023)
Odor	resembling humus soil / neutral	earthy smell / neutral	Syahri & Winarsih (2022)
Temperature	30-35°C	28-35 °C	Syahri & Winarsih (2022)

Solid organic fertilizer derived from goat manure is a type of fertilizer that is widely used because of its high nutrient content and its important role in improving soil structure. The physical quality of solid organic fertilizer can be a primary indicator of its maturity and effectiveness in supporting plant growth. Based on SNI 19-7030-2004 and SNI 7763-2018, several important parameters can be used to assess the physical quality of solid organic fertilizer, including color, odor, texture, pH, and temperature. The fine crumble organic fertilizer produced by the partner group has a dark brown to blackish color. This color indicates that the organic material has undergone complete decomposition and formed stable humus compounds. The dark color is caused by the end result of lignin and cellulose decomposition by microorganisms, which produce humic and fulvic substances as the main components of humus. Conversely, a light or yellowish color indicates that the material is not yet fully mature and still contains easily decomposed organic compounds that can cause phytotoxicity to plants (Sutanto, 2002). The texture of the fine crumble organic fertilizer from our partner group is crumbly and smooth. Quality organic fertilizer should be crumbly, friable, and smooth. A crumbly texture indicates the material has undergone physical and biological stabilization, making it easy to apply and mix evenly into the soil. A crumbly structure also enhances soil porosity, improves aeration, and increases the soil's ability to retain water and nutrients. Conversely, fertilizer that remains clumpy indicates too high a moisture content or an incomplete composting process (Hartatik *et al.*, 2010). Odor is also an important indicator of organic fertilizer maturity. The fine, crumble organic fertilizer produced by the partner group resembles humus soil, which is nearly neutral. Mature organic fertilizer has a distinctive, earthy smell that is mild and not overpowering. This odor comes from the compound geosmin produced by aerobic microbes when organic material has completely decomposed. Conversely, a sharp or pungent odor, such as that of ammonia or acid, indicates incomplete anaerobic decomposition, rendering the fertilizer unsuitable for use (Widowati, 2009). Fine crumble organic fertilizer products from partner groups have a temperature of 30–35 °C. The standard temperature for mature solid organic fertilizer is typically around 28–35 °C, which is close to ambient temperature (Syahri *et al.*, 2022). During the initial stages of composting, the temperature can rise to 45–60 °C due to the activity of thermophilic microorganisms that decompose complex organic matter. However, once the material is fully decomposed, microbial activity decreases and the temperature returns to normal. The high temperature of the final product indicates that the decomposition process is not complete, and the fertilizer is not yet suitable for use because it still has the potential to generate heat in the soil (Hartatik *et al.*, 2010). The fine crumble organic fertilizer produced by the partner group, which is primarily composed of goat manure, is classified as mature, stable, and safe for use on agricultural land. These characteristics not only meet the physical quality standards set by SNI but also demonstrate the fertilizer's biological effectiveness in enhancing the physical, chemical, and biological properties of the soil. Compost is an organic fertilizer derived from plant residues and animal waste through a decomposition process. Organic fertilizer is recommended to maximize plant growth and productivity (Reza *et al.*, 2021). The long-term use of organic fertilizers offers significant benefits for enhancing productivity in agriculture and plantations (Ganti *et al.*, 2023). A training session on packaging fine crumble organic fertilizer was conducted, emphasizing its importance in converting bulk organic fertilizer into value-added retail products. Effective packaging not only facilitates distribution but also stabilizes product quality by reducing contamination and moisture absorption. Additionally, it helps small-scale farmers utilize the product and enhances the marketability and image of the products offered by partner groups. During this community service training, participants learned about quality control, production record-keeping, pricing, and potential marketing strategies, both locally and online (Figure 5). By employing neat and consistent packaging techniques, the commercial value of the product can be significantly improved, aligning with existing literature on strategies to enhance the quality of organic products for marketing (Wijaya *et al.*, 2023).



Figure 5. Results of packaging fine crumble organic fertilizer products from partner groups.

The achievements of this community service activity demonstrate that the integration of technology transfer, practical training, and ongoing mentoring can significantly increase the capacity and quality of fine crumble organic fertilizer production from partner groups. Improving the quality of organic fertilizer provides direct benefits to the agricultural productivity of group members, while also supporting environmentally friendly livestock waste management. Unutilized waste from agricultural and livestock activities has the potential to cause environmental pollution, including water, air, and soil pollution, which can trigger methane gas emissions, act as a source of disease, and disrupt comfort (Nenobesi *et al.*, 2017). The success of this community service activity demonstrates the novelty of a One Health and sustainable development-based approach to community service, combining local resource potential, technology, and environmental health to empower communities. This approach not only enhances the technical capacity of group members but also fosters environmental awareness and economic independence through the production of high-quality local products.

CONCLUSION

Community service activities have successfully improved the skills of partner group members in producing organic fertilizer from goat manure through the application of Compost Maturation Technology. The final product, a fine crumble organic fertilizer, has a physical quality that meets SNI standards, indicating the maturity and biological stability of the fertilizer. The use of self-produced organic fertilizer can improve soil fertility, increase water and nutrient absorption capacity, and support the growth of plantation crops such as cloves, corn, and cassava. In addition, this activity supports the principles of sustainable agriculture by utilizing local resources efficiently and in an environmentally friendly manner. Periodic evaluation is necessary to ensure that fertilizer continues to meet quality standards and supports long-term soil health and fertility. The use of organic fertilizer should continue to be encouraged as part of a sustainable and eco-friendly agricultural system, especially in clove and annual crop plantations in partner group areas with mountainous topography and dominant clay soil, to increase soil fertility and plant productivity in an ecologically sound manner.

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