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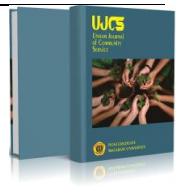

Optimization of Livestock Waste Through the Production of Liquid Organic Fertilizer from Animal Feces as an Ecological Step in Kalikuning Village

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Abstract: Liquid Organic Fertilizer (LOF) is the utilization of animal fecal waste, which contains nutrients and beneficial microbes that can be applied to plants. The animal feces are mixed with EM4, which serves as a source of microbes, while molasses comes from sugar production waste and functions as food for the EM4. By doing so, mixing livestock manure with these materials and then fermenting them for 7 days allows them to be used on plants, making them more fertile. This activity is used as an ecological step to reduce environmental pollution that can cause unpleasant odors and serve as a breeding ground for disease. The activity was conducted using Participatory Rural Appraisal (PRA) through the Student Community Service Program for Community Empowerment (KKN-PMM) for farmer groups and livestock breeder groups to increase harvest yields and reduce unpleasant odors released along with animal feces. The community of Kalikuning Village, especially farmers and livestock breeders, gained knowledge about making liquid organic fertilizer to improve soil fertility for their crops. Conclusion: The community of Kalikuning Village gained new knowledge and insights into spraying liquid organic fertilizer to achieve good crop quality through the transfer of knowledge from the UNSOED KKN-PMM Team to the local residents.

Keywords: Animal Feces, Fertilizer Innovation, Plants, Processing.

Introduction

Kalikuning Village is one of the villages located in Kalikajar District, Wonosobo Regency, Central Java, with abundant natural resource potential. Kalikuning Village is composed of a combination of 3 (three) hamlets: Kalikuning Hamlet, Ngadiloka Hamlet, and Semampir Hamlet. The community of Kalikuning Village generally makes a living as vegetable farmers and livestock breeders, both poultry and ruminants. The number of residents who work as livestock breeders is 200 people. However, a classic problem often faced is the accumulation of livestock faecal waste. Every day, livestock can produce large amounts of manure, approximately 12% of their body weight (Wirne & Dako, 2022). Livestock waste still contains nutrients and solid particles that can serve as a source of life for microorganisms, potentially leading to environmental pollution (Sulistyaningsih, 2020). However, livestock feces actually hold great potential because they contain important nutrients that can be processed into liquid organic fertilizer (LOF). Producing LOF can provide

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economic benefits while reducing negative environmental impacts.

Table 1. Table of Main Livelihood

Main Livelihood		
Type of Work	**Male**	**Female**
Farmer	195 people	40 people
Breeder	10 people	0 people
Does not have a permanent job	180 people	235 people
Retired personnel	3 people	0 people
Daily wage labourer	25 people	15 people
Driver	20 people	0 people
Total Population	723 people	

In the Community Empowerment Real Work Lecture Program (KKN-PMM), students carried out service in Kalikuning Village to help address some of the existing problems. This activity is an implementation of the Tri Dharma of Higher Education as mandated by Law Number 12 of 2012 concerning Higher Education, specifically in the aspect of community service (Rewa et al., 2022). This program is a manifestation of the application of science and technology in real activities with the community, with the hope that the presence of students can provide direct benefits and bring a positive impact on the development and welfare of the village residents. One of the proposed work programs is the production of Liquid Organic Fertilizer (LOF) from livestock fecal waste, which not only increases the waste's usefulness but is also an ecological step as it helps reduce environmental pollution.

Liquid organic fertilizer is a solution resulting from the decomposition of organic matter derived from plant residues, agro-industrial waste, animal manure, and human waste, containing more than one nutrient element (Tanti et al., 2019) a; (Rasmito et al., 2019). This process produces a solution rich in various essential elements, including nitrogen, phosphorus, potassium, enzymes, and hormones that support plant growth. Utilizing livestock waste to produce POC is a real-world example of applying the principles of circular economy and sustainable agriculture, where waste is no longer viewed as trash but as a resource that can be returned to the agricultural ecosystem to improve soil fertility.

The application of nutrients such as nitrogen, phosphorus, and potassium is very important in supporting plant growth. Nitrogen acts as an energy source for leaf growth (Fauzi et al., 2022). Phosphorus is a key component for improving plant root systems (Maulidan & Putra, 2024). Meanwhile, potassium helps regulate fruit formation. In addition, POC also contains microorganisms that can benefit the soil and plants as a whole. These microorganisms can increase microbial activity in the soil and decompose organic matter, gradually providing nutrients to the plants (Mau et al., 2025).

The use of liquid organic fertilizer based on livestock waste not only impacts soil fertility but can also improve the quality of food crops, especially vegetables and local food sources. Plants grown with organic fertilizer have better nutritional content, such as essential vitamins and minerals (Prasetyo & Evizal, 2021). Improving the quality and availability of nutritious food can help improve family nutritional intake. This is very important because nutritious food consumption is closely linked to the prevention of stunting. Stunting is a condition of chronic malnutrition that occurs due to inadequate nutrient intake over a long period (Nasriyah & Ediyono, 2023). Stunting can be characterized by impaired child growth, indicated by shorter height compared to the standard height for their age (Laili & Andriani, 2019). Stunting can be addressed indirectly by increasing the availability of healthy food free of chemical residues.

In response to the problem of livestock manure accumulation, which has the potential to pollute the environment, and the high risk of stunting in Kalikuning Village, the KKN-PMM UNSOED team proposed a work program themed "Optimizing Livestock Waste thru the Production of Liquid Organic Fertilizer (POC) from Livestock Manure as an Ecological Step in Kalikuning Village." The program aims to provide an environmentally friendly solution by utilizing livestock waste to create high-value products while also supporting the improvement of local food quality. The use of POC is expected to improve soil fertility, increase crop yields, and produce vegetables with higher nutritional content. Thus, this program not only contributes to waste management but also supports food security and stunting prevention in Kalikuning Village by providing healthier and more nutritious food.

Method

The Unsoed KKN-PMM activity was carried out in Kalikuning Village, Kalikajar District, Wonosobo Regency, Central Java, which has the potential of its residents, the majority of whom are livestock farmers and agriculturalists. This activity will be carried out over a period of 60 days from July to September 2025, with the focus of the activity being the production of Liquid Organic Fertilizer (LOF) to utilize animal manure. The participants or target community include 24 people from livestock farming groups. The implementation method adopted is the Participatory Rural Appraisal (PRA) approach, education, and mentoring, and it is also supplemented by the learning-by-doing technique. This

approach aims to address the problems of chemical fertilizer use in Kalikuning Village, which is harmful to plant development and the ecological balance of the environment. Through the PRA method, the active participation of the community is involved throughout the KKN PMM team's activities. The sequence of activities is as follows:

1. The initial stage involves observation activities to identify the main problems and determine the objectives.

   In this observation, it was found that the large amount of animal feces could cause unpleasant odors and disease nests for the residents of Kalikuning Village, making the identified problem the accumulation of animal waste. Based on the observation results, the KKN-PMM UNSOED team launched a work program to produce Liquid Organic Fertilizer (POC) to utilize livestock fecal waste as an environmentally friendly step. Additionally, it was identified that every household yard in Kalikuning Village is planted with crops, including vegetable plants like scallions, chili peppers, and so on, or flower plants. With the production of liquid organic fertilizer, the fertility of the soil will be further increased and the plant growth process will be improved due to the content found in the liquid organic fertilizer. The purpose of this activity is to achieve self-sufficient food security in every household.
2. The second stage is building public trust by establishing good communication regarding understanding the assistance provided for the problems of using chemical fertilizers.

   Next, after conducting observations as a preliminary survey, the KKN-PMM Team from UNSOED provided education to the community through socialization held at the Kalikuning Village Hall regarding how to make liquid organic fertilizer, its uses, advantages, and the benefits obtained from making liquid organic fertilizer. The socialization was held on July 17, 2025, with enthusiasm from the livestock group community to truly listen and take notes on the important points presented by the speaker.
3. The third stage is to take concrete action by going into the field with the participants to solve the problems.

   As a concrete step toward realizing the production of Liquid Organic Fertilizer (LOF), after conducting socialization, the KKN-PMM UNSOED Team provided guidance to farmer groups to practice making LOF. All tools and materials were provided by the KKN-PMM UNSOED Team. - The fourth stage is to provide periodic guidance on making liquid organic fertilizer. In this stage, the KKN PMM UNSOED Team continued to make LOF every 1 week, with the aim of making it together with the residents.
4. The final stage is to evaluate all program activities that have been carried out.

   This evaluation not only focuses on the technical aspects of producing Liquid Organic Fertilizer (LOF) but also considers the social and economic implications that arise. By involving participants in the evaluation process, it is hoped that constructive feedback can be obtained for future program improvement.

Result and Discussion

Livestock manure contains macro- and micronutrients that are very important for plants. Macro- and micronutrients are two types of soil nutrients distinguished by how much plants need them. Macronutrients such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S) are required by plants in large quantities, although their accumulation in plant tissues is relatively low, about 0.1% (Resthu et al., 2023). Animal feces that can be used for Liquid Organic Fertilizer (LOF) include sheep, chicken, cow, and so on.

The macro and micronutrients contained in animal feces vary depending on the type of animal. Sheep feces have a chemical composition that is beneficial for plants, including 1.28% nitrogen, 0.19% phosphorus, 0.93% calcium, 0.59% magnesium, 0.19% sulfur, and 0.020% iron (Dani et al., 2017). Meanwhile, cow manure is also rich in essential nutrients such as nitrogen (N), phosphate (P), potassium (K), and other minerals like magnesium, iron, and manganese. The average content in cow manure includes approximately 0.92% N, 1.03% K, 0.23% P, and 0.38% calcium (Ihsan, 2018). Cow manure also has the advantage of being free from heavy metals and antibiotics (Abidin & Novika, 2024). On the other hand, chicken manure contains nutrients such as 1% nitrogen (N), 0.80% phosphorus (P), 0.40% potassium (K), and approximately 55% water content (Ritonga et al., 2022).

Sheep manure is one of the most abundant forms of livestock waste in Kalikuning Village, as the majority of the local community raises sheep as a form of savings and a side job. Seeing the abundant potential of this waste, the KKN PMM UNSOED 2025 team initiated a work program consisting of socialization and practical training on making Liquid Organic Fertilizer (POC) as an environmentally friendlier and more affordable alternative to chemical fertilizers. The necessary ingredients include 250 ml of molasses, 250 ml of EM4 for livestock, 1.5 liters of water, and 1 kg of sheep manure. The necessary tools are a jerrycan and lid, a

bucket for mixing ingredients, a funnel, and a strainer. The process of making liquid organic fertilizer includes:

1. Preparing the tools and materials to be used;
2. Mixing 250 ml of molasses, 250 ml of EM4 for livestock, 1.5 liters of water, and 1 kg of animal manure;
3. Homogenizing (stirring until evenly mixed);
4. Pouring the mixed liquid into the jerrycan;
5. Close the jerrycan to create an anaerobic environment and allow fermentation for 14 days;
6. Open once a day and close again;
7. After 14 days, the POC is ready to use at a dosage of 15 cc/liter of water, applied every 7 to 10 days.

An additional advantage of sheep fecal POC lies in its content of beneficial microbes and natural phytohormones such as auxins and cytokinins, which have been shown to improve root growth, resistance to pathogens, and flowering in mustard greens, tomatoes, and chili peppers (Hastuti et al., 2021). By integrating ecological, economic, and technical aspects, sheep fecal POC emerges as an effective, environmentally friendly, and affordable alternative to chemical fertilizers for modern horticultural farmers.

The production of POC also requires EM4, or Effective Microorganisms. EM4 is a liquid containing beneficial microorganisms. Dewi (Dewi & Dewi, 2014) states that Effective Microorganisms (EM4) are a collection of beneficial bacteria created to help decompose livestock manure, allowing it to be processed into useful POC. EM4 contains various types of microorganisms, such as Actinomycetes sp. bacteria, photosynthetic bacteria (Rhodopseudomonas sp.), Streptomyces sp., cellulose-decomposing fungi, lactic acid bacteria (Lactobacillus sp.), and yeast. To optimize the process of making POC using EM4, molasses is needed as a supporting material to maximize the results obtained. Molasses is also needed in the production of POC, which is a liquid byproduct of sugarcane. Molasses has a distinctive brown color and a thick texture. Molasses contains sugar as an energy source for the fermentation process of microorganisms (Utomo et al., 2022). According to Kusmiati, molasses has a high enough nutrient content for bacterial growth, making it suitable for use as an energy source in the fermentation process.

The socialization on making POC was held on Thursday, July 17, 2025, at the Kalikuning Village Hall, with a total of 24 participants consisting of village officials and farmer groups from three hamlets. This socialization and practical activity aim to educate participants about the purpose, benefits, advantages, and steps for making liquid organic fertilizer (LOF) as an environmentally friendlier alternative to chemical fertilizers. After the material presentation session, the students continued with a live demonstration of the liquid organic fertilizer production process, which also involved participants actively participating. This activity received a very positive response from the community, who seemed enthusiastic about following each stage of the practice, including the fermented feed production session as part of utilizing livestock waste. The entire series of events took place in a conducive and participatory manner, reflecting good synergy between students and the community in realizing an environmentally based empowerment program.

Figure 1. Socialization of POC material by the KKN-PMM Team of UNSOED 2025

Figure 2. Practice of making liquid organic fertilizer with participants

Liquid organic fertilizer (LOF) shows significant environmental advantages compared to chemical fertilizers. Some studies reveal that excessive use of chemical fertilizers can reduce soil fertility and contaminate nearby water bodies, whereas POC actually improves soil structure by increasing porosity and water-holding capacity and maintaining soil microbial diversity, which is critical for nutrient cycling (Afa et al.,

2025). Thus, POC not only reduces the need for synthetic chemicals but also supports sustainable agricultural practices by naturally rehabilitating soil health.

In terms of nutrient efficiency, POC offers nutrients in a solution form that is ready for plant absorption without requiring further decomposition, unlike solid fertilizers, which need a long mineralization time. Research results show that the POC application increases the availability of nitrogen, phosphorus, and potassium in the root zone within 24–48 hours after application, thus supporting the vegetative growth phase and generative development of vegetable and horticultural crops. Additionally, using local sheep waste as a raw material for POC reduces farmers' production costs by up to 30% compared to purchasing commercial chemical fertilizers, making it an economical solution for small- to medium-scale businesses.

Thus, the application methods for sheep fecal POC include spraying the leaves and watering around the root system. Foliar spraying at a concentration of 5–10% utilizes stomata as a direct channel for nutrient absorption—especially during the early growth phase—while soil drenching at a concentration of 10–20% increases the activity of rhizosphere microbes, facilitating the slow release of nutrients. The recommended application frequency for vegetable crops is every 7–10 days during the vegetative phase, while for fruit and horticultural crops, POC is recommended during the flowering and fruiting phases to maximize fruit formation and the quality of the harvest, with a continuous increase in intensity.

Conclusion

Community empowerment-based service in Kalikuning Village, utilizing and adapting to the geographical, topographical, and social conditions within the community, led to the implementation of a work program consisting of socialization and practical guidance on making Liquid Organic Fertilizer (LOF) for farmer groups and livestock groups. The activity was carried out cooperatively and enthusiastically attended by local residents who wanted to learn about and directly witness the demonstration performed by the UNSOED 2025 KKN-PMM Team. This aims to increase the understanding of community members in realizing ecological steps to overcome livestock fecal waste. A total of 24 participants have practiced hands-on, with the expectation that they will be able to make POC independently. Additionally, utilizing livestock fecal waste has a positive impact on personal finances as it is more economical and efficient to produce. Thus, regular monitoring will continue to be conducted to spark the latest innovations in the future, implementing the development of technology and science in the years to come.

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