

Formulation and Application of Organic Fertilizer from Cow Dung to Increase Rice Yield by Applying Sustainable Agriculture Principles

Slamet Minardi¹, Sudadi¹, Isna Luthfa Haniati^{2*}, Sidik Pramono¹, Suryono¹

¹Department of Soil Science, Faculty of Agriculture, Universitas Sebelas Maret, Surakarta, Indonesia

²Agriculture, Fisheries, and Food Office of Semarang Regency, Central Java, Indonesia

*Corresponding Author: isnaluthfa@gmail.com

Submitted: 2023-01-04; Accepted: 2023-05-09

ABSTRACT

Livestock Farmer Group *Lembu Mulyo* was a cattle breeder engaged in livestock farming. Cow dung was a problem for breeders because of the large amount of cow dung that had not yet been utilized, causing air, water, and soil pollution. The Mentoring activity aims to overcome the problems faced by partners by utilizing cow dung waste from Livestock Farmer Group *Lembu Mulyo* could be used as organic fertilizer by the Farmer's Group *Sri Rejeki* to increase rice yield by applying the principles of sustainable agriculture. The Livestock Farmer Group *Lembu Mulyo* problem could be solved by formulating organic fertilizer using cow dung. Furthermore, it could address the Farmer's Group *Sri Rejeki* problem, which is an increasing need for fertilizer to increase rice yield by applying sustainable agriculture principles. The mentoring activity was in collaboration with two partners, namely the Farmer's Group *Sri Rejeki* and the Livestock Farmer Group *Lembu Mulyo*, located in Gesikan Village, Gantiwarno District, Klaten Regency. The method used was socialization and practice. The result of the mentoring activity for formulating organic fertilizer was that the Livestock Farmer Group *Lembu Mulyo* could formulate organic fertilizer from cow dung, and the Farmer's Group *Sri Rejeki* was able to apply an organic fertilizer to increase rice yield. The two partners' capabilities could overcome problems in the Livestock Farmer Group *Lembu Mulyo* and the Farmer's Group *Sri Rejeki*. In addition to solving the problems of the two partners by formulating organic fertilizers and their application in rice fields also applied sustainable agriculture principles.

Keywords: cow, fertilizer needs, manure, rice plants, sustainable agriculture

INTRODUCTION

Livestock Farmer Group *Lembu Mulyo* is a cattle breeder engaged in livestock farming. As with other livestock, cows also excrete large amounts of feces as waste products (Sukamta *et al.*, 2017). If livestock waste is not utilized, it will impact the environment through air, water, and soil pollution, thus becoming a source of disease (Ratriyanto *et al.*, 2019). The large amount of cow dung that has yet to be utilized causes cattle dung to increase daily, reaching 100 kg/day. One cow every day produces cow dung ranging from 8-10 kg per day or 2.6-3.6 tons per year or the equivalent of 1.5-2 tons of organic fertilizer so that it will reduce the use of inorganic fertilizers and speed up the land improvement process (Huda & Wikanta, 2017). Organic fertilizers such as manure are organic sources whose ingredients are affordable and easy to obtain from around the environment.

Organic fertilizers such as manure are intended to conserve soil by improving the soil's chemical, physical and biological properties (Minardi *et al.*, 2020). Formulating organic fertilizer from cow dung solves the problems of the Livestock Farmer Group *Lembu Mulyo* and the Farmer's Group *Sri Rejeki* problems.

The Farmer's Group *Sri Rejeki* fertilizer needs are increasing daily to increase production. However, the increasingly high fertilizer price is difficult for farmers to reach because of it. In addition, excessive use of chemical fertilizers will also damage soil fertility. The increasing need for food today has an impact on increasing the need for fertilizer. This is because fertilization is a way to correct plant nutrient needs in a way that is more directed, effective, and efficient (Minardi *et al.*, 2014). Fertilization needs to increase plant nutrients, either in the plant canopy or the soil, according to plant needs that aim to complement

the availability of nutrients (Fathin *et al.*, 2019). In this case, cow manure can increase the soil's ability to store water, mineralizing organic matter into nutrients that plants can use directly during their growth period (Raharjo *et al.*, 2022). The use of organic fertilizers needs to be applied in the concept of development of the agricultural sector. Organic farming by applying organic fertilizers can be a long-term solution to various potential problems in today's agriculture (Yuriansyah *et al.*, 2020).

Based on these conditions, it is appropriate to invite the Livestock Farmer Group *Lembu Mulyo* and the Farmer's Group *Sri Rejeki* to utilize existing resources. Formulating organic fertilizer using cow dung can be the right solution for the problems the two partners face. Composted cow dung using decomposer bacteria can make nutrients more available to plants and increase soil fertility continuously and, if done consistently, will create sustainable organic farming (Minardi & Hartati, 2017). This follows the mentoring activity's objective: to overcome the problems faced by partners by utilizing cow dung waste from Livestock Farmer Group *Lembu Mulyo* could be used as organic fertilizer by the Farmer's Group *Sri Rejeki* to increase rice yield by applying the principles of sustainable agriculture. Organic farming by applying organic fertilizers can be a long-term solution to various potential problems in today's agriculture (Yuriansyah *et al.*, 2020).

METHOD

The mentoring activity was in collaboration with two partners, Farmer's Group *Sri Rejeki* and Livestock Farmer Group *Lembu Mulyo*, located in Gesikan Village, Gantiwarno District, Klaten Regency. Farmer's Group *Sri Rejeki* was a partner in the rice farming business. Ten members of the farmer group own a five-hectare rice field. In one year, the rice field could be harvested three times, producing dry grain yields of about 4 tons of rice per hectare or 12 tons of dry grain harvested per hectare per year. Livestock Farmer Group *Lembu Mulyo* was a partner engaged in the cattle breeding business. This farmer group comprises ten members, each with an average of 2 to 3 cows.

Mentoring activities were carried out from June-November 2020. The method used is socialization and practice. The activities began with an initial survey, coordination with partners, preparation of materials, formulation,

and application of organic fertilizer, and monitoring and evaluation.

Initial survey

The community service team began by visiting Gesikan Village, Gantiwarno District, Klaten to determine partners and locations. This survey aimed to assess the condition of partners both in terms of knowledge of farmers and environmental conditions. In the initial survey, the community service team determined two partners: the Farmer's Group *Sri Rejeki* and the Livestock Farmer Group *Lembu Mulyo*.

Coordination with partners

The community service team coordinated with the two partners regarding the permitting process and determining the timing of socialization and practice activities. Furthermore, coordination was carried out to determine the materials needed by partners. In coordination activities, the time and place for socialization and the practice of formulating organic fertilizer and its application are determined. Based on the agreement, socialization activities and organic fertilizer formulation were conducted at the Livestock Farmer Group *Lembu Mulyo* House on June 20, 2020. An organic fertilizer application was carried out in rice fields on August 8, 2020, in a rice field owned by the Farmer's Group *Sri Rejeki*.

Preparation of practice tools and materials

The Livestock Farmer Group *Lembu Mulyo* prepared cow dung, molasses decomposers, and rice husk charcoal to formulate organic fertilizer in this activity. Hoes, shovels, buckets, and tarpaulins were also prepared as tools for Formulating organic fertilizer. The Farmer's Group *Sri Rejeki* prepares the land for organic fertilizer application.

The practice of formulating organic fertilizer

Formulating organic fertilizer by composting cow dung using starbio/decomposer bacteria could make nutrients more available to plants. The process of formulating organic fertilizer began by mixing about 100 ml of decomposer (EM4) with one bucket of molasses (sugar cane molasses), stirring evenly, and letting it stand for 15 days. The mixture would produce bacteria that function to decompose cow dung. Then the dried cow dung is mixed with

rice husk charcoal and a decomposer solution. After evenly stirring the cow dung mixture, the mixture was covered with tarpaulin for 15 days to optimize the fermentation process (Arif, 2020). The moving process had to be done every two days. After 15 days, the organic fertilizer was ready to be applied.

Organic fertilizer application

The rice field of the Farmer's Group *Sri Rejeki* was prepared to be applied with organic fertilizer formulated by the Livestock Farmer Group *Lembu Mulyo*. The application was carried out at tillage or the day before planting. When tillage was applied, organic fertilizer was spread evenly. Spreading was advantageous because it was easy and could act as mulch (Sugiatno, 2013).

Monitoring and evaluation

Organic fertilizer formulation from cow dung was monitored on July 11, 2020. During this monitoring activity, the community service team evaluated the maturity and suitability of the organic fertilizer belonging to the Livestock Farmer Group *Lembu Mulyo*. The second monitoring examined the results of applying organic fertilizer to rice plants in the Farmer's Group *Sri Rejeki*. This monitoring was carried out on October 19, 2020. The third monitoring was carried out on November 7, 2020, to monitor rice growth's physical properties after being given organic fertilizer.

RESULTS AND DISCUSSION

The socialization of formulating and applying organic fertilizers

The community service team visited partner locations to meet several potential mentoring participants from Farmer's Groups *Sri Rejeki* and Livestock Farmer Group *Lembu Mulyo* (Figure 1). In this socialization activity, the community service team explained that farmers would learn how to formulate and apply organic fertilizer on rice fields. As many as five participants from each partner participated in non-formal socialization at the house of one of the breeders in Livestock Farmer Group *Lembu Mulyo*. Participants comprised two farmers from the Farmer's Group *Sri Rejeki* and three from the Livestock Farmer Group *Lembu Mulyo*.



Figure 1. The community service team visits partner locations

During the socialization, the main topic of discussion was how to formulate organic fertilizer, with the main ingredient being cow dung and its application to rice fields. The farmers have been explained the dosage of ingredients and the stages that must be considered when formulating organic fertilizer. The community service team also explained the long-term benefits of organic fertilizer for soil health and rice production. Organic fertilizers that decompose into humus will provide available nutrients to increase the soil's water-holding capacity and improve soil structure and aeration during the soil's physical, biological, and chemical processes (Payebo & Ogidi, 2021).

Farmers are also taught about applying organic fertilizers in the best way and at the right time to obtain optimal yields. The community service team further explained that in mentoring activities, farmers would be invited to apply the concept of sustainable agriculture. Sustainable agriculture uses renewable and non-renewable resources for agricultural production processes in order to reduce the negative impact on the environment. In this case, the concept of sustainable agriculture that is applied is organic farming, which optimizes the utilization of natural resources, namely cow manure. The organic farming strategy quickly transferred nutrients from plant residues, compost, and manure into the soil (Widnyana *et al.*, 2020). Sustainable farming systems aim to reduce environmental damage, maintain agricultural productivity, increase farmers' income, and increase the stability and quality of life for people in rural areas. In principle, organic farming is in line with the development of agriculture with low-input technology and efforts toward sustainable agricultural development (Efendi, 2016).

The practice of formulating organic fertilizer from cow dung

After the socialization activities, farmers practiced formulating organic fertilizer from cow dung with the community service team. In this activity, farmers are enthusiastic about formulating organic fertilizer because farmers can utilize cow dung, which was initially a nuisance, into something of value. In the first step, farmers collected dry cow dung in one place and then added rice husk charcoal and a decomposer solution mixed with molasses (Figure 2). Afterwards, the mixture was stirred evenly and covered with a tarpaulin (Figure 3). The next step was to leave the mixture for 15 days, with an intensification of mixing once every 2 days. After 15 days, organic fertilizer is ready to be applied to the soil. The characteristics of manure ready to be applied were reduced odor, the original form was not visible, a cold temperature, and crumbly (Bidol & Rukaiyah, 2022). Additionally, it had a blackish-brown color and a high ability to bind water (Siswati *et al.*, 2021).

Organic fertilizer application on rice fields

Before applying organic fertilizer to the rice fields, the Farmer's Group *Sri Rejeki* prepared the rice field. The rice field preparation was carried out by tillage and making mounds. To make mounds, dig the land 20-25 cm deep, lift the soil to the left and right, and then level it. Mounds were made on rice fields to regulate drainage.

After the rice fields were ready, organic fertilizer was applied by spreading it over all the mounds (Figure 4). After the organic fertilizer was applied, the rice seeds were not planted immediately but were waiting for a day. This is intended to wait for the nutrients in manure to be available to plants because nutrients are released in organic fertilizers slowly (Slow release) (Arifah *et al.*, 2019).

Monitoring and evaluation of mentoring

Monitoring activities were carried out 3 times. The first mentoring was Formulating organic fertilizer, carried out on July 11, 2020. In this activity, the community service team checked the organic fertilizer belonging to the Livestock Farmer Group *Lembu Mulyo*. Based on the checking results, organic fertilizer has fulfilled the characteristics of mature and ready-to-use manure, which is blackish brown, has no smell, has a cold temperature, and is crumbly.



Figure 2. Addition of rice husk charcoal and decomposer solution to cow dung



Figure 3. Mixed cow dung covered with tarpaulin



Figure 4. Application of organic fertilizer on rice fields



Figure 5. Monitoring the results of organic fertilizer application on rice plants in the Farmer's Group *Sri Rejeki*

The second monitoring was to monitor rice yield after applying organic fertilizer in the Farmer's Group *Sri Rejeki* (Figure 5). This monitoring was conducted on October 19, 2020,

when the rice plants were 71 days old and had entered the generative phase. It was shown in this activity that rice plants that were given organic fertilizer could grow well. The third monitoring occurred when the rice plants were 90 days after planting (DAP) on November 7, 2020. At the age of 90 DAP, the rice plants entered the ripening phase of the ripe milk stage, which was marked by the rice plants still green but their panicles drooping, the lower stem segments looking yellow, and a milky liquid emerging when the grain was massaged with the fingernails.

Based on the Community Service Team evaluation results, the Livestock Farmer Group *Lembu Mulyo* was able to formulate organic fertilizer from cow dung. The Farmer's Group *Sri Rejeki* can also apply an organic fertilizer to rice plants. Both the Livestock Farmer Group *Lembu Mulyo* and the Farmer's Group *Sri Rejeki* had overcome problems with their capabilities. The problems of the two partners were solved with organic fertilizer formulation and application, which also applied sustainable agriculture principles. This agricultural principle did not damage or change the environment, was in harmony with the environment, maintained and improved environmental quality, and conserving natural resources.

CONCLUSION

Monitoring activities for formulating and applying organic fertilizer have been successfully implemented in the Gantiwarno District, Klaten Regency. The Livestock Farmer Group *Lembu Mulyo* made organic fertilizer from cow manure, and the Farmer's Group *Sri Rejeki* applied it to rice plants. The results obtained in this activity, partners' problems related to high cow dung and increased demand for fertilizer, were solved by formulating organic fertilizer from cow dung. Good management supported the Gantiwarno District, Klaten Regency to use environmentally friendly livestock practices, so it did not become a problem in the community. It could improve soil fertility, which in turn increases rice yield.

ACKNOWLEDGMENT

The author expresses his gratitude to Universitas Sebelas Maret for providing funds for community service activities through PNPB

funds for the 2020 Fiscal Year in Gantiwarno District, Klaten Regency.

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