

Original Research Paper

Community Empowerment Through the Solid Organic Fertilizer Production Program as a Waste Management Effort to Support Sustainable Agriculture in Jember Regency

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Abstract: Jember Regency has potential in the agricultural sector with abundant biodiversity, as well as a community culture that respects nature. This potential has not been managed optimally due to various problems such as limited creativity and knowledge of farmers regarding production, access, and limited market opportunities. To overcome this problem, it is necessary to empower the community through technology transfer, one of which is the manufacture of solid organic fertilizer from local ingredients in Jember district. This activity is an effort made to create environmentally friendly agriculture and can reduce organic waste pollution, one of which is animal waste. The specific aim of carrying out this activity is so that farmers can process organic materials in the surrounding environment to make organic fertilizer, thereby reducing farmers' dependence on inorganic fertilizers. This training in making organic fertilizer can increase farmers' knowledge and skills in increasing soil fertility and increasing production using organic materials. Implementation methods include socialization or counseling and training.

Keywords: community empowerment, fertilizer, chicken manure.

Introduction

Jember Regency has an area of 3.293,34 Km² and is surrounded by mountains that extend as the western and eastern boundaries. One of the villages in Jember Regency that has potential in agriculture is Panduman village. According to the 2010 census data from the Central Statistics Agency, Panduman village has 6.765 residents, most of whom earn a living as farmers.

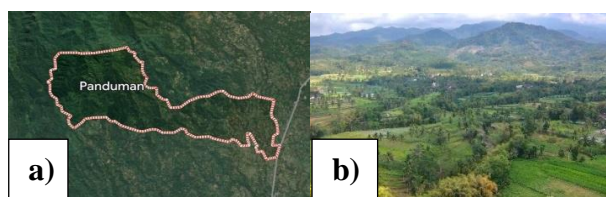


Figure 1. a) A series of Google satellite scene maps of Panduman Village; b) Panduman Village chili cultivation land. Agricultural commodities that are often planted in Jember Regency include rice, chili, tobacco, and corn. Meanwhile, plantation commodities include coffee, cocoa, and timber. Basically, in agricultural production activities, land conditions are very important for crop productivity.

In addition, climatic factors are also important, this is related to water supply during agricultural activities. The problem most felt by the community at this time is related to the scarce supply of fertilizers. Meanwhile, the demand for the fulfillment of soil nutrients to maintain fertility continues. In addition, the excessive use of chemical fertilizers for a long time can lead to a decrease in soil quality and land ecosystems (Hafiz et al., 2018). To maintain soil quality, the solution that can be offered is the application of Solid Organic Fertilizer. Solid organic fertilizer has a role as a nutrient enhancer for plants (Purnamasari et al., 2022). In general, solid organic fertilizers are made from agricultural waste and livestock waste. Fertilizers of animal origin can be divided into manure and waste from slaughterhouses, Animal feed that is processed into manure experiences a reduction in weight and density due to loss of carbon and water (Bergstrand, 2022). In the manufacture of solid organic fertilizer that occurs through the fermentation process, the content of nutrients and organic compounds it contains can be quickly absorbed by plants. The length of the solid organic fertilizer manufacturing process is influenced by the water content contained in it (Duaja, 2012). One of the livestock wastes that is widely found to be used as organic fertilizer, is chicken manure. Chicken manure is very rarely utilized by farmers because of its unpleasant smell. The content of nutrients in chicken manure is 1% nitrogen, 0.8% phosphorus, and 0.4% potassium, the nutrient content of chicken manure is higher than cow and goat manure which is not more than 0.6% (Tohari, 2009). In addition to chicken manure, several materials are easily found around Panduman village such as lamtoro leaves, grass, wood sawdust, banana stem, and so on. Chili farmers in Panduman Village are the target of this service activity. Training in making solid organic fertilizer by utilizing organic materials around farmers is expected to increase farmers' desire and skills in processing and utilizing organic materials into fertilizers with the achievement of environmentally friendly agriculture.

Materials and Methods

Community empowerment activities were carried out in Panduman Village, Jelbuk District,

Jember Regency in August 2023. The target of this community empowerment activity was the farming community in Jember Regency. The materials that need to be prepared in making solid organic fertilizer are plastic, paddles, choppers, and hoes. Meanwhile, the materials used are 50 kg of pure manure (chicken manure), 50 kg of grass, 2 meters of banana stems, and 1 liter of EM4. The first activity carried out in community service is a survey that aims to determine the conditions and needs of farmers. The second is that the activity of providing material or counseling is carried out using the active role of farmers. The material presented is in the form of theories about the impact of excessive use of chemical fertilizers over a long period, the meaning of solid organic fertilizer, the benefits of using organic fertilizer, as well as the mechanism for making and applying solid organic fertilizer made from animal waste. The third is a practical activity carried out to try to make solid organic fertilizer. The fourth is evaluation by conducting pre and post-tests regarding community understanding. The final activity is monitoring so that farmers have the enthusiasm to carry out and develop the fertilizer-making activities that have been implemented. Monitoring is carried out by conducting direct studies with the community through discussions or questions and answers.

Result and Discussions

The potential of agricultural waste in the agricultural sector is experiencing very positive growth supported by the contribution of each subsector. This is inseparable from the problems faced such as the lack of waste management in agriculture, one of which is livestock manure waste. If livestock manure waste is managed properly, it will produce organic fertilizer that is beneficial for farming activities. The use of organic fertilizers in the long term can increase land productivity and prevent land degradation. The application of organic fertilizers can improve the physical, chemical, and biological properties of the soil either directly or indirectly (Zulkarnain et al., 2013). The availability of chicken manure is very abundant due to the rapid development of livestock in the poultry sector. Chicken manure has high levels of nutrients and organic matter and low moisture content. One chicken produces excreta amounting to 6.6% of live weight per day (Taiganides, 1978). Chicken manure

contains 1% N, 0.80% P, 0.40% K, and 55% moisture (Lingga, 1999). Chicken manure has a higher content of nutrients and organic matter compared to other animal manure, especially N, P, and organic matter (Firdaus, 2011). The composition of chicken manure varies greatly depending on the physiological properties of chickens, rations, and cage environments such as temperature and humidity. The abundance of chicken manure is a great opportunity to be developed further so that it can reduce the economy of the local community. Based on the potential of chicken manure waste, an alternative form of waste treatment is to manage it into solid organic fertilizer.

Socialization of Solid Organic Fertilizer

The socialization related to the utilization of agricultural waste into solid organic fertilizer was attended by 30 farmers. The socialization activity was divided into several events including an opening, pretest, presentation of material, discussion session, practice of making fertilizer, and posttest. The material presented to farmers was related to the understanding and advantages of solid organic fertilizer, manufacturing procedures, and its application.



Figure 2. a) Series documentation of socialization, presentation of material regarding waste management into solid organic fertilizer; b) pretest and posttest work

Evaluation of farmers' understanding is carried out using pretest and posttest. There were five questions asked to determine farmers' knowledge about solid organic fertilizer. The pretest and posttest given were grouped into two categories, namely questions number 1 to 3 were included in the general knowledge category about solid organic fertilizer compared to chemical fertilizer, and numbers 4 and 5 showed the farmer's skill category in processing solid organic fertilizer. The following table of results shows an increase in farmer knowledge of 73%.

Table 1. Pretest and Posttest Evaluation of Socialization Activities

No.	Question	Pretest (%)		Posttest (%)	
		Yes	No	Yes	No
1.	Are you familiar with Solid Organic Fertilizer?	27	73	100	0
2.	Do you know the benefits of Solid Organic Fertilizer?	17	83	100	0
3.	Do you know the negative impact of using chemical fertilizers?	0	100	100	0
4.	Do you know the main ingredients of Solid Organic Fertilizer?	10	90	100	0
5.	Do you know the steps to make Solid Organic Fertilizer?	83	17	100	0
Average		27	73	100	0

Evaluation of activities based on Table 1 shows that the pretest results show that 27% of farmers already know the answers to the questions and 73% of farmers do not yet know the answers to the questions given. After the extension activities were carried out, the evaluation results showed that 100% of farmers understood the answers to the questions given. The pretest answer to the first question regarding knowledge of solid organic fertilizer showed that 27% of farmers already knew about solid organic fertilizer and 73% did not know about solid organic fertilizer. In the second question, 17% of farmers knew the positive impact of using solid organic fertilizer on the environment and cultivated plants, and 83% of farmers did not know the benefits of solid organic fertilizer. In the third question, all farmers do not know the negative impacts of using chemical fertilizers. The fourth question shows that 10% of farmers know solid organic fertilizer ingredients and 90% of farmers do not know solid organic fertilizer ingredients. Last question, 83% of farmers know how to make organic fertilizer by composting, but 17% of farmers don't know how to make solid organic fertilizer.

Practices for Making Solid Organic Fertilizers

How to make solid organic fertilizer using chicken manure as the main ingredient:

1. Prepare tools and materials
2. Chopping all forages and banana stems into small pieces to accelerate the decomposition process
3. Looking for a manufacturing location that is located in a shaded place or not exposed to full sunlight
4. Roll out tarpaulin or plastic mulch as a base
5. Put in the kandang fertilizer, then the chopped forage material, and put in the chopped banana stem.
6. After reaching each certain thickness (25-30 cm), then water the material with diluted
7. EM4 and then stack the material again, and so on.
8. Mixing or stirring all the ingredients together (animal waste, forage, banana fronds, and EM4) and adding water up to 30-40%, then mixing well.
9. Cover the fertilizer with tarpaulin or used mulch until it is tight or anaerobic
10. Perform anaerobic fermentation for at least 30 days, the longer the better.

In Solid Organic Fertilizer activities, apart from the basic ingredients of chicken manure, there are also additional ingredients such as banana stem which contains many gara elements such as Nitrogen, Calcium, and Potassium, and trigger the presence of microorganisms that decompose organic matter (Bago, 2021). In addition, there is forage material from grass which functions as an enhancer of soil nutrient availability. The material is chopped small with a size of about 2-4 cm. If the material is chopped too large, it will inhibit the decomposition process, if the material is chopped with a very small size, it will cause the breakdown of oxygen diffusion so that anaerobic bacterial activity occurs (Suhastyo, 2017). EM4 has a role as a decomposer of organic matter. In the practice of making solid organic fertilizer, it is necessary to pay attention to the manufacturing steps so that the fertilizer made is successful.



Figure 3. Series of documentation of practical activities for making solid organic fertilizer: a) chopping banana stem; b) mixing all ingredients

The farmers were very enthusiastic about practicing making solid organic fertilizer. With the training activities, farmers became more eager to implement organic farming or cultivation. Even one of the farmers has the desire to produce solid organic fertilizer to be marketed. Solid organic fertilizer can be harvested in about 1-2 months.

Table 2. Properties of chicken manure solid organic fertilizer

No.	Characteristic	Analysis Results	SNI 7763:2018 Test Quality Requirements	Information
1.	Total N	1,45 %	0,40	Eligible
2.	C-Organic	36,43 %	9,8 - 32	Not Eligible
3.	pH	6,6	6,80 – 7,49	Not Eligible
4.	Water Rate	22,38 %	8 – 25	Eligible
5.	P ₂ O ₅	0,19 %	0,10	Eligible
6.	K ₂ O	0,52 %	0,20	Eligible
7.	(NPK)	2,16 %	Maks. 2	Eligible

C-Organic

Organic matter content has a very important role in improving the quality of soil fertility, increasing biological activity in the soil, and increasing the availability of nutrients for plants. Based on the analysis results, the C-organic value was 36,43%. The test results exceed SNI test quality requirements, namely 32%, so it can be said that solid organic fertilizer is still not fully mature, to reduce high organic C, high N is needed. If the C-organic content ranges between 9,8 – 32%, it indicates that the solid organic fertilizer has met SNI test quality requirements and is ready for use. The higher the level of C-Organic, the fertilizer given will improve the quality of the soil, because organic material plays an important role in improving soil properties, such as physical properties, chemical properties, and biological properties.

pH

Fluctuations in the pH of organic fertilizer will occur during decomposition. The decomposition process is considered good if there is an increase in pH from the start of production until the solid organic fertilizer matures. The decrease in pH occurs due to the oxidation of inorganic compounds which produces H⁺ cations, while the increase in pH is caused by the

mineralization of organic materials into cations. Another factor that causes an increase in pH is thought to be due to the change in organic acids into carbon dioxide so that the amount of organic acids decreases. Based on the analysis results, the pH of solid organic fertilizer is 6,6 so it does not meet SNI test quality requirements. This is thought to be because the decomposition or composting process has not been evenly distributed throughout, so the pH has not yet increased. During the composting process, the degree of acidity is related to the activity of decomposing microorganisms. When the activity of microorganisms increases in the process of breaking down organic material, heat energy will be produced which causes the temperature of the compost to increase and causes the pH to also increase.

Water Rate

Based on the analysis results, it was found that the water content in the solid organic fertilizer sample was 22.38%. These results are by the SNI test quality standards, namely 8 – 25%. This water content is good because water content that is too low or too high will result in the composting process being inefficient and having a greater potential for failure.

N-Total

One important indicator to determine the suitability of solid organic fertilizer can be seen in the N-total content because N-total affects the C/N ratio of the solid organic fertilizer produced. Protein synthesis will occur during the composting process. Microorganisms use N to carry out protein synthesis, along with the composting process the amount will increase. The analysis results of good solid organic fertilizer must exceed the SNI test quality requirements value, namely 0.40%. The analysis results show a value of 1.45% which means more than 0.40% so solid organic fertilizer is suitable for use. The nitrogen content is caused by the addition of bacteria to composted chicken manure. Total N levels are related to organic C levels, this is because microorganisms use carbon as an energy source for decomposition to produce carbon dioxide which causes carbon levels to decrease and nitrogen levels to increase.

P-Total

The final result of making solid organic fertilizer must exceed SNI test quality requirements, namely 0.10% P content. If the P content is less than 0.10%, it means that the fertilizer is not suitable and has almost no P nutrients. The analysis results show that the P content is 0.19% thus exceeding 0.10%. A high phosphorus content is also influenced by a high nitrogen content. If the nitrogen content is high, the decomposing microorganisms will also increase and result in the phosphorus element also increasing.

K-Total

Potassium is a compound produced from metabolic processes in microbes, where microbes use free potassium ions in fertilizer raw materials to meet the metabolic needs of plants. The analysis results show that the K-total value meets SNI test quality requirements, namely 0.52% with a minimum limit of 0.20%. K-total has increased due to the activity of microorganisms decomposing organic matter, which use potassium as a catalyst so that the activity and presence of bacteria can influence the increase in potassium in composting solid organic fertilizer.

Macro Nutrients

Macronutrients are substances that plants need in large quantities. These nutrients include total levels of N (total N), P (P₂O₅), and K (K₂O). According to SNI test quality requirements, the maximum nutrient content is 2%. From the results of the analysis, it was found that the nutrient content was above the standard, namely 2.16%. The availability of sufficient nitrogen makes plants grow quickly and produce green leaves, as well as produce crops of good quality or quantity. If there is a lack of nitrogen in the soil, plant growth will be disrupted and plant yields will decrease because the process of chlorophyll formation is very important in stunting plant growth. Other nutrients needed by plants are phosphorus (P) and potassium (K). The phosphorus and potassium contents each meet the SNI test quality standards.

Conclusions

In general, community service activities in Panduman Village, Jelbuk District, Jember

Regency ran smoothly and were welcomed by the community very enthusiastically. This can be seen from the implementation of the pre and post-tests, where initially only 27% of the farmers who took part in the activity understood the questions, after socialization 100% of the farmers who took part in the activity understood the questions given and supported the desire to make solid organic fertilizer. Making solid organic fertilizer using chicken manure as a base material has C-organic, pH, water content, and NPK analysis results that meet SNI test quality requirements and are suitable for application to plants. By holding this program, it is hoped that it can help the community overcome the problem of fertilizer scarcity and processing of livestock waste, especially chicken manure so that it can provide added value.

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