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Training on making rice straw-based compost for farmer group in Prafi District, Manokwari Regency

Pelatihan pembuatan kompos berbasis jerami padi bagi kelompok peternak di Distrik Prafi, Kabupaten Manokwari

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ABSTRACT

Farmers in Prafi District often experience problems with the availability of inorganic fertilizers, so it is necessary to provide organic fertilizer. The objectives were (1) to provide insight into the role of environmentally friendly fertilizers for soil and plants; (2) to transfer knowledge and technology for composting based on rice straw waste; (3) to assist farmers in Prafi District, in overcoming the problem of scarcity and high prices of fertilizers. This training was held in Aimasi Village, Prafi District, which was attended by 24 members of Harapan Makmur group and Petani Peternak Terpadu Sebelas group. The training included preparation of materials, counseling, and practice, application of compost to plants, and evaluation. The results of the activity showed that the participants gave a very good response to the introduction of composting technology made from a mixture of rice straw and cow feces. Farmers were able to make compost, so there was no need to buy fertilizers used for planting vegetables and fruits. Moisture content, organic matter, C-total, and N-total of rice straw-based compost were within the criteria of SNI compost. It was concluded that most of the farmers had understood the material provided and had been able to independently make compost with good quality.

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1. INTRODUCTION

Prafi is a district of Manokwari Regency that was targeted for national transmigration placement in the late 1980s. Prafi District located at 133°361'40" – 133°531'40" east longitude and 0°431'0"–0°571'08" south latitude, it has an area of ± 383 Km2. Prafi District is a home for 17,783 people which has a density of 58.19 people/km2 (BPS Manokwari Regency, 2021). Around 73.06% of the population have a

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livelihood as farmers and ranchers. Livestock business has a high economic value because it functions as a household savings. On average, farmers in Prafi District raise cattle with ownership level of 3-5 heads/family. One of the villages in the Prafi District is Udapi Hilir Village. This village is about 45 km from the city of Manokwari and can be reached by land transportation.

The use of fertilizers is an important strategy because it increases the productivity of food crops. Availability of inorganic fertilizers such as urea and NPK in Prafi District is often limited. If there are any, the price is too high considering the transportation cost required to deliver from Manokwari City. Therefore, it is necessary to provide organic fertilizers as an alternative.

According to the BPS report of Manokwari Regency (2021), rice field in Prafi District has an area of 822.5 ha which produces around 1,438.5 tons rice straw each harvest season. Based on the observation, it is shown that only a small portion of rice straw waste is used as animal feed while most of it is left to decompose naturally in paddy fields, or even burned and causing air pollution. This waste has the potential to be processed into a compost, because it still contains 1.29% nitrogen and 2.94% potassium needed by plants (Idawati et al., 2017).

Compost is an organic fertilizer that comes from crop residues and animal waste which has undergone decomposition or weathering. Composting is a biological decomposition process of organic matter by microbes that utilize organic matter as an energy source in order to reduce the C/N content of organic matter until it reaches the same level as the C/N of the soil (< 20). Chemical elements changed during composting are: (1) carbohydrates, cellulose, hemicellulose, fat and wax into CO2 and H2O, (2) decomposition of organic compounds into absorbable compounds for plants (Prihandini and Purwanto, 2007).

Compost has the ability to loosen the soil, increase the soil particles adhesiveness to improve the soil structure so it is more resistant to erosion, increase the soil to water binding capacity, provides macro and micro nutrients for the soil, and facilitates the growth of plant roots (Latifah, Tobing, & Martial, 2014). Furthermore, compost also capable of broadening the diversity of soil microorganism hence soil biological activity will be increased. In addition, these microbes help plants to absorb nutrients from the soil and help to deal with plant disease. Plants fertilized using compost tend to have a higher quality than plants using chemical fertilizers, for example, yields are more durable, heavier, fresher, tastier, safer and healthier for human consumption.

According to Idawati et al. (2017), the decomposition of rice straw into compost with the treatment of biodecomposers PROMI and EM4 resulted in a C/N value of 14.56 on day 28. This value is still in the range of ideal C/N values of 10 - 20 which is recommended in SNI 19-7030-2004 (BSN, 2001). Dulbari et al. (2018) concluded that the use of straw compost was proven to increase the nutrient content and organic matter content of paddy fields. Likewise, Pane, Damanik, & Sitorus (2014) concluded that the application of rice straw compost to maize plants could increase the organic C- and P-available Ultisol soil, N and P uptake, plant height and dry weight.

The Harapan Makmur Group is a farmer group located in Udaphilir Village, Prafi District. This group has 32 members who breeds Bali Cattle and Kali Gesing Goats. There are 149 goats that are kept, consisting of 41 males and 108 females. The goats are kept by each farmer with an average ownership of 5 heads. In addition, there is an in Prafi District there is an Integrated Livestock Farmers Group named "Sebelas". The group has 11 members with the main job as farmers and a side business of fattening beef cattle. Currently, there are 73 beef cattle kept by the group, in average each farmer maintains 4-5 cows. The results of observations and identification in both groups revealed several problems, namely: (a) limited knowledge and information about the potential of rice straw which is widely available in rice fields as a source of organic matter to maintain land fertility; (b) farmers/breeders often burn rice straw because they think it can hinder the process of land preparation; (c) limited skills possessed by farmers/breeders to process rice straw into compost as a source of organic matter.

The description above shows that in Aimasi Village, Prafi District, has the potential for rice straw and manure which can be processed into compost. Compost has the ability to promote nutrients in agricultural land owned by farmers/breeders. Therefore, it is necessary to conduct training to improve their knowledge and skills to utilize rice straw as a compost.

The objectives of this community service are (1) to provide insight about environmentally friendly fertilizers for soil and plants; (2) transforming knowledge and technology of compost making based on rice straw waste to members of the Harapan Makmur farmer/breeder group and the Integrated Livestock Farmers Group "Sebelas" in Prafi District, Manokwari Regency; (3) assisting farmers in Prafi District to overcome the problem of scarcity and high prices of fertilizers by utilizing organic fertilizers in their agricultural land.

2. METHODS

The socialization was carried out at The Head of Aimasi Village office, Prafi District, Manokwari Regency and continued with the practice at the Livestock Waste Management warehouse in Aimasi Village, Prafi District, Manokwari Regency (Figure 1). This activity lasts for 5 months, starting from the materials preparation, coordination, to program evaluation. Participants who took part in the activity were 24 people consisting of 13 members of the Harapan Makmur farmer group and 11 members of the Integrated Farmers Group "Sebelas".

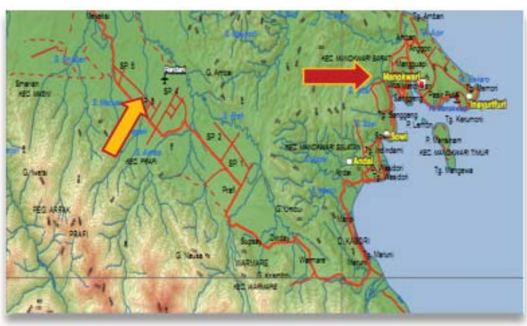

Figure 1. The location of Aimasi Village, Prafi District, Manokwari Regency (yellow arrow) is 50 km from the Papua University Campus (red arrow)

Materials Preparation

Straw and rice bran obtained from paddy fields and a rice mill located in SP3, Prafi District. The rice straw is sun dried, then stored in the Livestock Waste Management warehouse until the implementation of the practice. The preparation of composting materials is coordinated by each group leader.

Figure 2. Pile of dry rice straw in rice fields (left) and burnt rice straw (right). (Source: Field Observation Results).

Preparation of Socialization and Practice

The service team submitted a permit for the implementation of activities to the Institute for Research and Community Service at the University of Papua to be submitted to the head of the district. The service team then coordinates with the district head on the implementation plan of this activity. Furthermore, the district head will coordinate with the village head and group leaders regarding the place and time of socialization and the practice of making rice straw-based compost.

Implementation of Socialization and Practice

This activity was carried out in several stages: (1) Socialization to farmers was carried out at the Aimasi Village Office, Prafi District (Figure 3). This socialization aims to provide an understanding of soil fertility and efforts to improve soil fertility, the benefits of organic fertilizer for soil and plants, as well as technology for making compost based on rice straw and cow dung. (2) Socialization is carried out using InFocus media, besides that each participant is given a hand out/leaflet about the technique of making compost using rice straw and cow dung as raw materials. After the delivery of the material, the discussion continued and on that occasion the socialization participants were given the opportunity to ask questions.

Figure 3. Socialization of compost making technology based on rice straw and cow manure (Source: activity documentation results)

The practice of making compost based on rice straw and cow dung was carried out at the Livestock Waste Management warehouse in Aimasi Village, Prafi District. The members of the livestock group who attended were divided into 2 groups of 12 people each so that the participants could practice the knowledge that the service team had given them. The composition of the ingredients for rice straw-based compost is shown in Table 1.

Table 1. Composition of Composting Ingredients for Rice Straw

Ingredients	Amount
Rice straw (kg)	100
Rice bran (kg)	5
Cow dung (kg)	40
Top soil (kg)	15
Sugar (spoon)	5
EM4 (ml)	100
Water (liter)	10

The procedure of making rice straw-based compost is as follows: (a) dry rice straw is chopped using a chopper; (b) cow dung, topsoil, rice straw and rice bran mixed evenly while stirring; (c) EM4 solution and sugar is poured slowly and stirred with a mixture of cow dung and other ingredients until evenly distributed; (d) the mixture is spread on the floor with a thickness of 10-15 cm, then covered with a tarpaulin; (e) the compost material is turned over 4 times on the 4th, 7th, 14th, 21st and 28th days; (f) the decomposition process is carried out for 35 days, then followed by sampling to analyze the quality of compost and application of compost to plants.

Application of Compost on Plants

The application of compost was carried out on several betel plants belonging to one of the participants in the activity. Fertilization of betel plants is done every 2 months. Then the farmer observes the growth of betel plants that have been given compost.

Evaluation of Activity Result

At the end of this activity, an evaluation was established by assessing the level of understanding, skills and changes in how farmers accept technological innovations for making rice straw based compost. The criteria used to measure the success of this activity are: (1) Ninety percent of the farmers participating in the training masters the knowledge and understand the technology to process rice straw into compost. (2) Eighty percent of the trainee farmers can process rice straw waste into compost independently. (3) Seventy percent of the farmers participating in the training were able to make good quality rice straw-based compost.

RESULT AND DISCUSSION

Socialization activity

To improve the knowledge and skills of farmers/breeders in Aimasi Village, Prafi District, Manokwari Regency, training activities were carried out in the form of socialization and followed by demonstrations. The rice straw-based composting training has taken place according to the planned stages, namely (a) preparation of materials, locations, and participants; (b) implementation, includes socialization and practice/demonstration; (c) application of fertilizers to crops; and (d) monitoring and evaluation. The socialization lasted for 3 hours which was attended by 24 members of the farmer group accompanied by the village head and extension workers. Activity participants easily understand the material presented because the participants in this activity are farmers and/or ranchers who carry out daily activities in rice fields and raise cows and goats. Before the socialization activity ended, a two-way discussion was held between the presenters and the activity participants. One of the indicators that can be used to measure the level of seriousness of participants in participating in socialization activities is the number of questions asked by participants. Most of the breeders in SP3 Prafi District do not use rice straw as animal feed because they can still get fresh animal feed, both grass and legumes around rice fields and gardens. The rice straw is returned to the ground or left to dry in the paddy fields and then burned before the next planting period, causing air pollution (Figure 2).

After participating in this activity, farmer and breeders will change their perspective that inorganic fertilizers usage is the only guaranteed way to obtain high agricultural production results. In fact, the use of inorganic fertilizers for a long period of time causes lack of organic matters in the soil. Therefore, this socialization activity reduces the farmers dependence on the inorganic fertilizer usage. Kartasapoetra (1993) stated that socialization or counseling aims to foster changes regarding the level of knowledge, skills or attitudes of the extension participants. One of the indicators used to measure the effectiveness of the implementation of socialization/counseling is the broadening knowledge. Firdausi, Adriansyah, & Khafid (2018) reported that socialization carried out continuously can increase farmers' knowledge from good criteria to very good criteria.

Rice Straw-Based Compost Making

The practice of making rice straw-based compost was followed by all participants who were divided into 2 groups. Each group made a mixture of compost ingredients (Table 1) with a total weight of about 320 kg. Participants accompanied by service team carried out all stages of composting, starting with chopping rice straw, weighing each ingredient, mixing the ingredients until covering the mixture using a tarpaulin so that the decomposition process obtained. Likewise, at the composting stage on days 4, 7, 14, 21 and 28, 2-3 participants from each group took turns turning and observing changes in the texture of the compost accompanied by a service team. Driven by a very high curiosity and a strong determination to improve knowledge and skills in making compost, farmers/breeders were very enthusiastic about following each step in the practice of making straw compost. Thus, at the end of the activity, each training participant was able to make rice straw compost independently.

According to Pranata, Pratiwi, & Rahanto (2011), it is necessary to pay attention to principles, including developing community potential, increasing community contribution, developing a culture of mutual cooperation, working with the community, community-based education, partnership and decentralization during community empowerment. The activities carried out by the service team have implemented these principles, namely growing the potential of the community by processing the rice straw and livestock manure as compost materials. Furthermore, to increase the community's contribution, all participants are given the opportunity to participate in the socialization as well as to practice composting. The cultural aspect of mutual cooperation and working with the community can be seen from the preparation of composting materials to the application of fertilizer to plants. Community-based education is implemented by providing the widest possible opportunity for farmers/breeders in Aimasi Village to take part in training activities in order to increase their knowledge and skills.

Quality of The Rice Straw Compost

Compost is an organic fertilizer derived from crop residues and animal waste that has undergone a decomposition or weathering process. Rice straw found in paddy fields is biomass which still contains C-organic 39.54%, N-total 1.74%, C/N 22.72 (Setiawati et al., 2019). Meanwhile, Santoso and Hariadi (2009) stated that rice straw contains 1.1% N and a high crude fiber component of 71.1% NDF. Cow dung contains N (± 2%), P, K and fiber-digesting bacteria (cellulolytic). The physical characteristics of compost made from a mixture of rice straw and cow dung are presented in Table 2.

Table 2. Changes in Color, Odor and Texture of Rice Straw Based Compost during the Composting Stage

Day	Color	Odor	Texture
1	Light green brown	Smell of straw	A bit stiff and rough
4	Light brown	Hint of acids	A bit rough
7	Light brown	Acids smell	A bit rough
14	Dark brown	Smell of decomposition process	A bit rough
21	Light brown	Smell of soil	Smoother
28	Blackish brown	Smell of soil	Soil-like

Based on the observations of physical changes, it can be seen that the decomposition process of organic matter in the formation of compost has been running perfectly. At the last stage (day 28/week IV) there was a change in odor from the smell of straw to a soil-like odor, the rough texture became crumbs like earth and the green brown color easily became blackish brown. The color of the compost produced in this activity is in accordance with that reported by Matheus, Kantur, & Bora (2017) that rice straw that is processed into compost using a biodgra type decomposer produces a blackish brown color. According to Latifah, Tobing, & Martial (2014), the characteristics of mature compost are (1) the original material has been destroyed and is almost invisible, in the form of earthy crumbs; (2) reddish brown or black compost; (3) compost is not hot and stable at room temperature; (4) the material does not smell bad. Several factors affect the composting process, according to Hartawan, Nengsih, & Marwan (2017) are the water content of the compost material, the Carbon (C) content of the compost material, the size of the compost material, and the number of starters used.

Effective Microorganism 4 (EM4) which is used as a bioactivator in the process of making rice straw compost looks effective in helping the decomposition process. It can be seen that on day 21, the smell of compost has resembled the smell of earth. According to Manuputty, Jacob, & Haumahu (2012) that the lowest C/N value of waste compost was found in the effective treatment of PROMI and EM4 inoculants with a concentration of 48 g PROMI and 300 ml of EM4. This is due to the addition of effective inoculants PROMI and EM4 can increase the population of decomposing microorganisms so the compost mature quicker. The nutrient content of straw compost which has been decomposed for 35 days is presented in Table 3.

Table 3. Nutrient Content (%) Rice Straw Compost

Nutrient Content	%
Water	38,7
Organic matters	37,4
C-Total	15,53
N-Total	0,73
C/N	21
P (P_2O_5)	0,44
K (K_2O)	4,10

Source: Laboratory Analysis Result

The average water content and organic matter content of rice straw compost are below the maximum value of water content and the minimum value of organic matter according to SNI Compost 19-7030-2004, namely 50% and 27%, respectively. Likewise, the content of C-Total and N-Total is above the minimum value specified in the SNI, namely 9.8% and 0.4%. However, the C/N value slightly exceeds the maximum limit of the SNI provisions, which is 20%. The phosphorus content (P2O5) of rice straw compost is above the minimum value listed in the SNI, namely 0.1%. Manuputty, Jacob, & Haumahu (2012) reported that the C/N values in waste compost treated with PROMI and EM4 were 11.88 and 11.56, respectively. Meanwhile, Idawati et al. (2017) obtained a C/N value of 14.56% in rice straw compost using Promi and EM4 bio-decomposers. The value of the C/N ratio at the end of incubation of 14.56 was good enough to be applied to the soil to improve its fertility level. Bio-decomposer is a mixture of microorganisms that serves to accelerate the process of decomposition of organic matter from plant residues into compost. In addition, according to Amnah and Friska (2019), the process of chopping compost material into fine sizes can help microbes degrade. If the content of C or N is excessive, it can affect the composting process, because microbes use C as a source of energy and growth, while N is important for protein synthesis and reproduction processes. According to Siboro, Surya, & Herlina (2013) the principle of composting is to reduce the C/N ratio of organic matter until it is equal to the C/N of the soil (<20). If the C/N value is high it is not good for plants and at the time of application to plants there will be competition between plants and microbes in the absorption of nutrients available in the soil. Conversely, if the C/N content of the compost is low, it means that the nutrients bound to the compost have been released through the mineralization process so that they can be used by plants.

Evaluation of Composting and its Application on Plants

Based on the evaluation of the training participants, it showed that most (>90%) of the participants had mastered the provided materials. The next evaluation was carried out 3 months after the training which shows that >80% of the participants had been able to independently make good quality rice straw-based compost. After participating in this activity, farmers/breeders make rice straw-based compost consistently so they don't need to buy fertilizers.

According to Situmorang (1995), the main factors to improve person's knowledge are the ability, need, experience and the high and low mobility of information material about the environment. Furthermore, several factors that can influence the formation of attitudes are information access, personal experience, culture, other people who are considered important, mass media, emotional factors within the individual (Azwar, 2013). Therefore, this activity will increase the knowledge, skills, and the behavior of farmers/breeders to process rice straw into compost.

The application of rice straw compost on betel plants showed good plant growth indicated by dark green leaves and more betel fruit produced. This proves that the compost is containing nutrients needed by the soil and plants. According to Dulbari et al. (2018), the addition of rice straw compost to paddy fields caused an increase in the concentration of N-Total and C-Organic, respectively, by 244% and 64%.

As a follow-up to this training activity, farmers/breeders in Aimasi Village, Prafi District continue to make rice straw-based compost on a regular basis. Every 2-3 training participants are able to produce 150 kg compost every month. This fertilizer has been able to meet the fertilizer needs for vegetable crops in their respective fields. From the results of this training activity, group members benefit from being able to save costs on purchasing fertilizers and earn money from selling fruits and vegetables.

3. CONCLUSION AND RECOMMENDATIONS

The members of the Harapan Makmur breeder group and the "Sebelas" Group which were the targets of the activity gave a very good response to this compost-making training. Participants have mastered the material provided and have been able to independently make good quality rice straw-based compost. The water content, organic matter, C-Total, N-Total and P contained in rice straw compost are within the range of compost quality standards based on SNI. The average production of compost produced by 2-3 farmers/breeders is 150 kg/month which can meet the fertilizer needs of their respective fields.

This socialization activity needs to be carried out in several locations in Prafi District, because there is a lot of rice straw waste that has not been utilized. To facilitate the enumeration of rice straw, the relevant agencies need to provide assistance with a chopper.

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