Empowering Of Communities Receiving Aid Of Organic Fertilizer Processing Units ("UPPO") With Quality And Packaging Improvement In Indonesia

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Abstract: "UPPO" development has become a strategic component in increasing the income of farmers and encouraging the use of organic fertilizer in farming. The Indonesian government has realized 68 UPPO aid packages for the province of West Sumatra. In reality on the ground, 72% of UPPO is producing below its capacity. This activity aims to empower UPPO through the introduction of organic fertilizer processing technology that meets quality standards and packaging improvements. Raso farmer groups in the city of Payakumbuh serve as pilot projects in this activity. The method of this activity is learning by doing with intensive coaching. The results of the activity showed an increase in the quality of organic fertilizers so that it meets the quality standards of Permentan no. 70-2011. Improved packaging with brand printing and nutrient content information makes packaging more attractive and informative. Based on the decrease in water content, resistant organic fertilizer is stored for 3 weeks in the marketing period. It is hoped that this technology can be disseminated to UPPO recipients in Indonesia and similar programs in the world.

Keywords: cattle manure, farmer groups, organic fertilizer, packaging, pilot project, Quality standard, UPPO

1. INTRODUCTION

Cattle manure is a threat to the environment and a potential source of income for livestock farming. Cattle manure waste management needs to be done well so as not to pollute the water environment, air and even vegetation [1]. Piles of cattle manure will be fermented by indigenous microorganisms that produce methane gas and nitric oxide which contribute 20-30% of greenhouse gases from the agricultural sector [2]. Conversely, cattle manure that is processed into organic fertilizer can be an additional potential for farming income so that waste turns into a co-product of livestock farming [3]. The liquid and solid cattle waste have an advantage as fertilizer. Liquid waste (urine) is containing growth plant stimulants [4] and a slurry biogas digester waste from cow dung can be used as nutrients for hydroponics [5]. Processing of cattle manure into organic fertilizer has been done for a long time by farmers known as manure fertilizer, which is cattle manure which is piled up behind the cage until it dries and is brought to the field as plant fertilizer. However, the quality of manure fertilizer is still low and gives a slow response for plants. This happens because the fermentation of manure is not perfect so it takes time to decompose in the soil before it can be absorbed by the roots of plants. The quality of manure fertilizer is reported to have nutrient content N: 0.4%; P: 0.2%; K2O5: 0.1% [6]. This content is low from the standard of Republic of Indonesia Minister of Agriculture Regulation No. 11-2011 which requires a minimum amount of N + P + K of 4%.Efforts to improve the quality of organic fertilizers aim to encourage increased use of organic fertilizers and reduce the use of inorganic fertilizers in agricultural. Recognizing the dangers of using inorganic fertilizers, the Indonesian government encourages the use of organic fertilizers by providing production equipment of organic fertilizer. "Raso" farmer group is one of the recipients of the aid of the Organic Fertilizer Processing Unit ("UPPO") from the Agriculture and Food Crops Office of West Sumatra Province in 2011. Based on reports from field observations of the Livestock and Animal Health Service Office of West Sumatra Province explain that 72% of UPPO in West Sumatra producing under their capacity.

The Raso farmer group is one of the UPPOs in West Sumatra that has low production. Some of the problems identified were the use of non-standard fertilizer raw materials, the quality of the organic fertilizer produced was not yet measured and the fertilizer packaging was not good. The solution offered is the reformulate of raw material, nutrient analysis in the laboratory and packaging improvements. This activity aims to increase the independence of the group in producing quality organic fertilizers optimally. This activity is a pilot project to empower 68 UPPO in West Sumatra Province.

2 PROCEDURE

2.1 Profile of farmer groups

Community empowerment activities in producing quality organic fertilizer in partnership with Raso farmer groups are in the village of Ompang Tanah Sirah, North Payakumbuh sub-district, Payakumbuh city, West Sumatera province, Indonesia. This farmer group is led by Mr. M. Zamzami dt. Jindo Kayo has 15 members and runs a beef cattle breeding business. In 2011 the Raso farmers group received the aid of an organic fertilizer processing unit ("UPPO") with a value of 340 million rupiahs. This aid was realized into 1 unit of cattle enclosure; 35 beef cattle of Bali Cattle breed; 1 unit of factory building; 1 unit of a motorized pedicab and 1 unit of crusher machinery. The Raso farmer groups are actively expanding their business and the present condition cattle populations are 31 beef cattle of Simental and organic fertilizer production averaging 5 tons/month. Organic fertilizer is marketed through collaboration with several stakeholders, namely CV Delta Jember, the Office of the Environment and the Department of

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Food Security of Payakumbuh. Organic fertilizer is selling at Rp. 800 / kg. The raw material as production input is cattle manure is provided from group cattle farms with the availability of 11.6 tons/month.

2.2 Technology Transfer Method

Technology transfer from the promotor team to the target audience of the Raso farmer group was carried out using the "learning by doing" method. The target audience is all members of the Raso farmer group, but for the transfer of technology using 4 people as audience target, namely the chairman and 3 influential members in the group. The series of stages of technology transfer is expected to reach the stage of technology adoption by the target audience. The stages of the activity began with the lecture counseling method to motivate the target audience, followed by work guidance for the organic fertilizer production process interspersed with discussion and evaluation.

2.3 Reformulation of raw materials

Reformulation of raw material for organic fertilizer is intended to improve the quality of organic fertilizer produced. Changes to the formula from the old formula which is the formula of organic fertilizer used before the activity becomes a new formula that is the formula that is introduced in community empowerment activities. Changes formula of raw materials is shown in Table 1.

TABLE 1
REFORMULATED RAW MATERIAL FOR ORGANIC FERTILIZER

Items	Old Formula[1])	New Formula[2])
	.....(% wb).....	
Cattle manure	78	75
Ash of husk combustion	20	-
Grass of left over-feed	-	10
Rice straw/ Jerami/ weed litter	-	15
EM4[3])	2	-
Indigenous microbial	√	√

[1])Old formula: formula used before community empowerment activities
[2]) New formula: formula used in community empowerment activities
[3]) Effective microorganism 4

Fig. 1. *Crusher machine for grinding organic fertilizer*
A: complete machine
B: rollers component

The production process is carried out at the UPPO factory owned by the Raso farmer group with a volume of 1 ton each for the old formula and the new formula. For old formula is carried out by mixed cattle manure + ash of husk combustion then it is doused with a solution containing 1 liter of Effective microorganism 4 (EM4) + 4 liters of water. Then covered with plastic sheeting and incubated for 3 weeks. Stirring the ingredients is done at the end of the first week and the second week. Fermentation is stopped at the end of the third week by opening the cover sheet plastic and the fertilizer is left to dry for 1 week, then grinding and the fertilizer is ready for sale. The production process for the new formula begins with the mixing of raw materials according to the composition of the formula, then adjustment of water content. If the raw material does not drip water between the fingers when it is clenched, it shows that the water content of the material is appropriate, which is around 50% and continued to stacked for fermentation. Conversely, if the water droplets are found out, it indicates that the material containing water is too high, then it is aerated for 24 hours and then stacked for fermentation. The fermentation process is done by stacking the material on the floor as high as ± 60 cm and left for 2 weeks without reversal. After the fermentation, the fertilizer condition is relatively dry because the fermentation heat will evaporate the water content of the material so that the fertilizer is ready to be ground. Grinding is done with a Crusher machine that has 18 blades as shown in Figure 1. The results of grinding with this

Crusher machine are relatively mash, so it does not require sifting.

2.4 Quality parameters analysis

Quality analysis is carried out in a laboratory to measure several quality parameters. Fertilizer water content was determined by the percentage of total evaporation of water by heating it in an oven at 105 °C for 24 hours. The difference in water content with 100% dry matter is the percentage of dry matter content in organic fertilizer. After the analysis of the dry matter is continued with the determination of levels of organic and inorganic materials through ashing in the furnace at 400 °C. The acidity of organic fertilizer is determined using a pH meter (Hi9807-phep) and the C-organic content is determined by the titrimetry method. Nitrogen content in organic fertilizer is determined by the Kjeldahl method. Analysis of Proximate continuation [7] was carried out to determine phosphorus nutrient levels. Pollutants are determined from the percentage of the weight of contaminants (plastic, gravel, iron, glass, etc.) in 100 grams of organic fertilizer. Determination of the quality of organic fertilizer produced is done by comparing the results of organic fertilizer quality tests from laboratory analysis with quality standards. The quality standard used in Regulation of the Minister of Agriculture number: 70/Permentan/SR.140/10/2011 concerning organic fertilizers, biological fertilizers, and soil enhancers. Quality comparison is focused on macro-nutrient content and supporting criteria such as pH, water content, organic matter content, and others.

2.5 Screen printing of Packaging

The screen printing technique of packaging is carried out using a T150 screen with HD glossy vinyl ink. The packaging label is designed with CorelDraw software version 12 and the results are printed with a printer (HP Laserjet Professional P1102w). Working in a dark room, the screen is coated with an Ulano 133 emulsion and then dried with a hairdryer for 3 minutes. The design paper is smeared with coconut oil so that the paper becomes transparent, then place it on the screen. Give lighting for 20 seconds then spray with water until the cover slides with water according to the design pattern. Printing is done by smear the ink on the screen that is placed on top of the package being printed. The ink will be printed on a package according to the screen image pattern.

3 RESULTS AND DISCUSSION

3.1. Quality of Organic Fertilizers

Table 2 shows that the quality of the organic fertilizer from the new formula is better than the old formula. The macronutrient content of nitrogen (N) and phosphorus (P) which is the main indicator shows the old formula does not meet the standard while the new formula can meet the standard. The standards that the government has put forward through Permentan no 70-2011 outline a minimum number 4% of nitrogen + phosphorus (P_2O_5) + potassium (K_2O). In the old formula, the number of these three elements is 3.98 while in the new formula the number of elements N and P is 4.29 excluding elements K. In the old formula, there is an imbalance of nutrients where element K is high (2.54%) while N (0.95%) and P (0.40%) low. This is due to the use of combustion ashes in the old formula. The use of 100% of cattle manure has not been able to produce quality organic fertilizer, so it is necessary to add other organic materials. The quality of organic fertilizer is largely determined by the raw material [8] and the fermentation process [9]. The fermentation process is influenced by the C/N ratio, size, composition of the material, the number of microbes, humidity, aeration, temperature, and acidity [10]. In the old formula using EM4 microbes containing photosynthetic bacteria that required higher water content in the material. In the new formula, it relies on microbial indigenous which is the digestive tract microbes that are carried along with animal manure. The fermentation process can take place both aerobic and anaerobic. The aerobic process will produce CO_2, H_2O, and heat while the anaerobic process will produce CH_4, CO_2, and organic acids [11]. The C/N ratio of old formula organic fertilizer is 9.58 and has met the standard, while the new formula is 15.66 does not meet the standard. The high C/N ratio in new formula organic fertilizers is due to the higher C/N ratio of the base material and the fermentation time is too short so that the C-organic content is still high beside the nitrogen content is high. In the old formula, cattle manure has a C/N ratio of 25.00 whereas in the new formula with the addition of feed residue grass and rice straw the C/N ratio is higher to be 30.05. The fermentation process in principle reduces the C/N ratio of raw materials so that the organic fertilizer produced has the same C/N ratio or approaches the soil C/N ratio. During the fermentation process, there will be degradation of organic compounds such as carbohydrates, crude proteins, fats and minerals by microbes producing CO_2, methane, and water [2]. Optimal fermentation temperature is 30-50 °C with 60% humidity, at this temperature bacteria and fungi work optimally while pathogenic bacteria and weed seeds will die. The material moisture content needs to be considered to create the temperature and humidity following the growth of microbes. If the moisture content of the material is too high, the fermentation temperature will be low which causes the microbes to not work or be dormant. Conversely, if the water content is too low, the fermentation temperature will be high which can cause the death of the fermentor microbes. Reversal is done if the fermentation temperature is too high (> 60 °C) to keep the microbes from dying and at the same time for aeration. The process of decomposition of basic ingredients into organic fertilizer during the fermentation process is affected by the water content of the ingredients. The moisture content of the ingredients in the old formula ± 80% is expected to work photosynthetic bacteria from EM4 (bacterivores). In the new formula, it is expected to work with microbial indigenous,

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TABLE 2
COMPARISON OF THE QUALITY OF ORGANIC FERTILIZERS BEFORE AND AFTER SERVICE ACTIVITIES CONNECTED WITH THE PERMENTAN QUALITY STANDARD NO 70-2011

Parameters	Score		Standard quality of Permentan 70-2011	Quality achievement *)	
	Old formula	New formula		Old formula	New formula
	---------- % ----------				
pH	9.22	8.72	4-9	NS	S
Water content	8.65	41.86	15-25	NS	NS
Dry matter	91.35	58.14	-	-	-
Inorganic matter	30.18	19.83	-	-	-
Organic matter	69.82	80.17	-	-	-
C-organic	14.88	20.21	Min. 15	S	S
Nitrogen	0.95	2.11	N+P+K Min. 4	NS	S
Phosphor	0.40	2.18		NS	S
Kalium	2.54	-		S	-
C/N ratio	15.66	9.58	15-25	S	NS
Pollutant	1.69	1.45	Max. 2	S	S

*) S: meets the standards; NS: does not meet the standard

especially fungi (fungivores), so that the water content is ± 50%. Microorganisms decompose organic matter optimally working at 40-60.5% water content [12]. The water content is too high causing the fermentation process to last longer, conversely, if it is too low the efficiency of degradation of organic matter decreases due to lack of water availability for the solvent of organic material to be decomposed [13].

3.2. Packaging and Storage

The packaging of organic fertilizer produced in this activity uses 33 x 55 cm plastic sacks. The sack is given a brand screen printing as shown in Figure 2. Consideration of the choice of packaging type is the value of efficient production costs and the protection of packaging to product. Poly-Ethylene (PE) plastic packaging is considered good because the price is cheap, strong and can protect the product from environmental air humidity and product water evaporation.

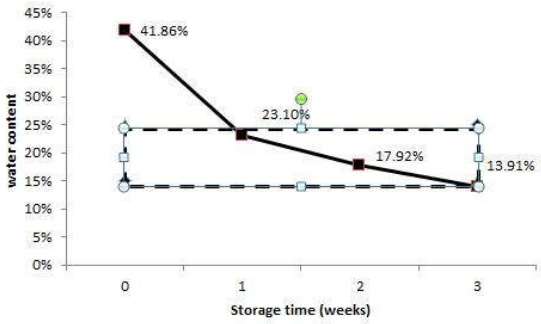

Fig. 3. Changes in the water content of organic fertilizer during storage.
Water content standard limits

On the fertilizer packaging displayed of fertilizer nutrients content, prices, and fertilizer producer namely the Raso Farmers Group and the supervisor of Agricultural Polytechnic Payakumbuh. An attractive and informative packaging appearance turns out to give a positive image of the customer to the product. The appearance of packaging becomes urgent in the development of the organic fertilizer market because it must compete with the many other organic fertilizer products that have been circulating in the market. The amount of organic, biological fertilizer and soil ameliorating in Indonesia in 2015 recorded 753 brands [14].

4 CONCLUSION

Processing of organic fertilizer using a new formula with the composition of raw materials 75% cow dung + 10% feed residue grass + 15% straw/weed litter can produce quality organic fertilizer according to the standard of Permentan No. 70 of 2011. Microbial indigenous, namely the digestive tract microbes carried with cow dung can ferment the basic ingredients of fertilizer without the addition of other inoculant microbes. Fertilizer packaging using plastic bags with branded screen printing and nutrient information has been to generate attractive and informative packaging to increase the selling power of organic fertilizer products. Fertilizer expiration is set for 3 months with consideration of decreasing water content during storage up to the standard limit.

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