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Education and Mentoring on Organic Fertilizer Processing Using PGPR Biodecomposer in Bakalan "*Babe*" Youth Organization, Bululawang, Malang Regency

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Abstract: *The existence of Minister of Agriculture Regulation Number 10 of 2022 concerning restrictions on national fertilizer subsidies among farmers requires alternative development of fertilizer processing. This Community Service aims to educate and assist the BABE* Youth Organization *and residents of Bakalan village, Bululawang, Malang Regency in the Rapid Processing of Organic Fertilizer using the Plant Growth Promoting Rhizobacteria (PGPR) Biodecomposer. The implementation method uses the ABCD (Asset Based Community Development) method by providing education and mentoring to partners so they can develop the potential to increase employment and income in the surrounding area. The results of the education show an increase in knowledge and understanding regarding the fast processing of organic fertilizer by 51%. The results of trial mentoring, organic fertilizer formulation, and the production process show an increase in the ability of the workforce to increase production so that people's income increases. In conclusion, this service can increase the knowledge and skills of the residents of Bakalan Village, especially the independence of the BABE* Youth Organization*, Bululawang District, Malang Regency in processing PGPR organic fertilizer to support Food Security through Local Fertilizer Self-Sufficiency.*

Keywords: *education, mentoring, organic fertilizer, decomposer, PGPR*

Introduction

Bakalan Village is one of the villages with the most plantation land and rice fields. Most of the people of Bakalan Village work as entrepreneurs, farmers, and also breeders. The number of livestock in Bakalan village is increasing from year to year[1]. Each farmer in Bakalan Village on average keeps around 2 cows. Each farmer in the hamlet produces

[1] J. Ansori, *Peranan Kepala Desa Dalam Menggerakkan Partisipasi Masyarakat Terhadap Pembangunan Sarana Fisik Desa* (Laporan Studi Desa Bakalan Kecamatan Bululawang Kabupaten Malang, 2010).

around 20-25 kg of cow dung waste a day, but the livestock dung produced has not been utilized optimally so it is necessary to apply cow dung waste processing technology[2].

The disposal of livestock waste which is usually carried out by the people of Bakalan Village is divided into two, the first is that livestock waste is burned and the second is that livestock waste is placed in a special area for livestock waste, then left to sit until it dries/mixes with the soil, of course this results in air pollution, unpleasant odors, pollution of water and land, and lack of environmental cleanliness which can disturb the surrounding community. [3]. Farmers also experience confusion in disposing of livestock waste if the landfill is full. This data shows that the number of livestock in each hamlet is very large and can increase every year. The increase in livestock will also increase the amount of waste from livestock manure, resulting in a shortage of disposal places.[4]. Based on these problems, there is a need for education on the use of livestock manure waste in organic fertilizer, considering that in Bakalan Village people generally work as farmers. It is hoped that making organic fertilizer will be able to improve the abilities of program partners in aspects of education, economics, health, and social behavior. [5, 6].

The target partners for this community mentoring program are Youth Organizations and residents of Bakalan Village. Youth Organization *BABE* is a village Youth Organization that has an economically non-productive status and acts as a means of liaison with the residents of Bakalan Village. Of course, it also plays a role in making this community service program activity a success by obtaining appropriate technology education for processing livestock waste into organic fertilizer in Bakalan Village, receiving assistance. The production process of processing livestock waste into organic fertilizer and packaging as well as marketing the product in the surrounding area. It is also hoped that this activity can improve healthy living behavior which can minimize the source of the spread of disease. The potential and business opportunities for partners are 782 farmers/breeders and 1,075 people who are not yet working to run this business unit.

Cow dung waste has the potential to be used as an organic fertilizer because it contains nutrients such as nitrogen, phosphorus, and potassium so this waste can be used

[2] M. Muharsono, "Strategi Pemerintah Dalam Pengelolaan Limbah Peternakan (Studi Di Desa Sendang Kecamatan Sendang Kabupaten Tulungagung)," *Publiciana* 14, no. 1 (2021): 188–212, https://doi.org/10.36563/publiciana.v14i1.300.

[3] A. Indri, S. Marina, and M. M. Ali, "Persepsi Masyarakat Terhadap Manfaat dan Dampak Negatif Limbah Peternakan Sapi Perah (Kasus di Desa Rancamulya Kecamatan Sumedang Utara Kabupaten Sumedang)," *Students E-Journal* 4, no. 3 (2015): 1–14.

[4] F. R. Widyastuti, Purwanto, and Hadiyanto, "Upaya Pengelolaan Lingkungan Usaha Peternakan Sapi di Kawasan Usahatani Terpadu Bangka Botanical Garden Pangkalpinang," in *Prosiding Seminar Nasional Pengelolaan Sumber Daya Alam dan Lingkungan dalam Mewujudkan Pembangunan Berkelanjutan*, vol. 237 (2013): 81–85.

[5] L. Melsasail, V. W. R., and Y. E. B. Kamagi, "Analis Kandungan Unsur Hara Pafa Kotoran Sapi di Daerah Dataran Tinggi dan Dataran Rendah," *Cocos* 10, no. 8 (2018).

[6] M. A. Kusumadewi, A. Suyanto, and B. Suwerda, "Kandungan Nitrogen, Phosphor, Kalium, dan pH Pupuk Organik Cair dari Sampah Buah Pasar Berdasarkan Variasi Waktu," *Jurnal Kesehatan Lingkungan* 11, no. 2 (2019): 92–99.

as a soil conditioner and also functions to increase plant growth[7]. Cow dung that is simply thrown away in a special manure area can be used as a place for fermentation and decomposition of organic materials with the help of PGPR (Plant Growth Promoting Rhizobacteria) starter bacteria in an aerobic manner[8,] to reduce the odor pollution that arises and converting this organic material into marketability by using it to improve the quality of soil in agricultural areas owned by the community. In this activity, a processing process will be carried out using straw crushing technology and mixing with cow dung waste and the addition of PGPR (Plant Growth Promoting Rhizobacteria) decomposer to optimize the decomposition process and produce organic fertilizer in powder form, this Community Service aims to educate and assist the BABE youth group and the residents of Bakalan in the production process of Rapid Processing of Organic Fertilizer using the PGPR Biodecomposer.

Methode

The IKU (Key Performance Indicators) for this activity are (1) the existence of appropriate technology for bacterial bio decomposer products selected by PGPR on starter media for rapid processing of organic fertilizer products, (2) the existence of appropriate technology for crushing and mixing raw materials such as straw and cattle waste into products organic fertilizer in powder form, (3) production management of organic fertilizer products, and (4) proper and good product packaging, (5) marketing management of organic fertilizer products. The focus of this community service activity is the application of appropriate technology to quickly process cattle waste and straw into organic fertilizer using the PGPR biodecomposer with BABE Youth Organization partners and the community of Bakalan village, Bululawang District, Malang Regency.

The implementation method of this community partnership program is carried out by providing outreach (education)[9,] which is continued with assistance in making designs for tools for crushing mixing, and production. The approach method used is the *ABCD* (Asset Based Community Development) mentoring method, By helps partners to develop existing potential and ultimately provides results in increasing income and employment in the surrounding area. In mentoring using the *ABCD* method, the mentor prioritizes utilizing the assets and potential that Bakalan Village already has[10]. The model for implementing this activity will be carried out directly (face to face) as in a conversation between the

[7] D. Nenobesi, W. Mella, and P. Soetedjo, "Pemanfaatan Limbah Padat Kompos Kotoran Ternak dalam Meningkatkan Daya Dukung Lingkungan dan Biomasa Tanaman Kacang Hijau (Vigna Radiata L.) Varietas Vima 1," *Jurnal Bumi Lestari* 17, no. 1 (2017): 69–81.

[8] E. A. Gashash et al., "Effects of Plant-Growth-Promoting Rhizobacteria (PGPR) and Cyanobacteria on Botanical Characteristics of Tomato (Solanum lycopersicon L.) Plants," *Plants* 11, no. 20 (2022): 1–16, https://doi.org/10.3390/plants11202732.

[9] M. Sridevi and K. V. Mallaiah, "Production of Hydroxmate-type Siderophores by Rhizobium Strains from Sesban (L.) Merr," *International Journal of Soil Science* 3, no. 1 (2008): 24–34.

[10] E. Husen, "Screening of Soil Bacteria for Plant Growth Promotion Activities in Vitro," *Indonesian Journal of Agricultural Sciences* 4, no. 1 (2016): 27–31, https://doi.org/10.21082/ijas.v4n1.2003.p27-31.

implementing team and the activity participants, who in this case are partners. Training and mentoring are carried out in the 3rd and 5th months. Through this program, it is hoped that the partner team from Bakalan Village will gain clear knowledge and understanding about processing cow dung waste. Where the processing process is carried out by cutting straw and mixing it with cow dung using a machine, then adding a PGPR bacterial starter and drying it in the sun covered with a tarpaulin until the decomposition process is complete. With this training, it is hoped that they will be more independent in making organic fertilizer. It is hoped that the output obtained from the training and mentoring of the partner teams who are continuously involved in this training activity will provide insight knowledge and skills that will be disseminated to other residents.

In carrying out training and mentoring activities, several methods are used, including the lecture method, question and answer method, and simulation method.

1. Lecture Method
   In this method, several things will be conveyed, namely that cow dung waste has good prospects for being processed into organic fertilizer which functions as a soil conditioner and functions to improve soil structure and increase nutrients in the soil. It is hoped that technologically standardized organic fertilizer production can provide a solution to the problem of unutilized manure waste.
2. Question and Answer Method
   This method provides an opportunity to discuss and exchange ideas. In this method, people can also ask questions about things they don't understand.
3. Simulation Method
   In this method, the assistant provides an overview of the process of making organic fertilizer in several ways, including dividing modules, playing videos, and providing examples of making products directly. After going through several of the methods above, assistance was also provided which included assistance in processing organic fertilizer using crushing and mixing methods. Then proceed with assistance in packaging organic fertilizer so that it can be sold on the market, either sold directly as a business unit or sold online through digital marketing. Digital marketing is a marketing or promotional activity for a brand or product using digital media or the internet [11].

Stages in Making Cattle Manure Waste into Organic Fertilizer. Ingredients include 80 – 83% cow manure, 5% rice straw powder, 0.25% PGPR biodecomposer, 10% husk ash, and 2% lime. The processing stages include collecting cow dung (feces and urine) and draining it for one week to reduce the water content (± 60%); The drained cow dung is then transferred to the first plot. In this place, organic materials such as crushed straw pieces, husk ash, lime, and PGPR decomposer are mixed; before the organic materials and decomposer are mixed into the cow dung, it is best to mix the four organic materials (rice

[11] U. Chakraborty, B. Chakraborty, and M. Basnet, "Plant Growth Promotion and Induction of Resistance in Camellia sinensis by Bacillus megaterium," *Journal of Basic Microbiology* 46, no. 3 (2006): 186–195, https://doi.org/10.1002/jobm.200510050.

straw powder, husk ash, lime, and decomposer) first, so that they are evenly distributed, and mixed evenly into the cow dung that has been prepared in the first place; for every 1 ton (1000 kg) of livestock manure the organic materials mixed are 50 kg of straw powder, 100 kg of husk ash, 20 kg of lime and 2.5 kg of decomposer; After a week it is reversed and moved to a second location, left for a week. After a week it is moved to the third location and so on until it is in the fourth plot and kept for one week, and in the fourth week the compost is ready and to get a uniform shape it is filtered or sifted to separate it from gravel or pieces of wood and so on. Next, the compost is ready to be applied to land or plants. Characteristics of Organic Fertilizer with PGPR Biodecomposer include blackish brown color; does not smell bad; the texture of the compost is slightly fibrous; the water content when clenched tightly does not become hard lumps, when the fist is opened it also does not break apart like dry sand, contains nutrients that are available for plants; high water binding ability[12,13].

Results

The initial effort is to educate the technology for processing livestock waste into organic fertilizer by creating a processing center for cattle waste and straw processing using appropriate crushing and mixing technology into organic fertilizer products in powder form using the PGPR decomposer. Second, collaborative assistance to invite the BABE Youth Organization in Bakalan Village, Bululawang District, Malang Regency a Youth Organization is a non-productive community group as a means of connecting with residents of Bakalan Village and its surroundings who will produce the organic fertilizer. Third, the finished organic fertilizer is tested in the laboratory to determine the quality of the fertilizer produced. Then the fertilizer is packaged well and marketed as a business unit for residents. This organic fertilizer is expected to have selling power or even as a business unit that can collaborate with BUMN/Government to be able to supply organic fertilizer for distribution to a wider marketing area in the Malang area and its surroundings. The stages of activities that have been implemented are as follows:

Survey Activities

Location surveys were carried out at the location of the village land and residents' land that was permitted to be used for fertilizer processing. During this survey, land arrangements were also planned for the position of making cow dung collection tents and the decomposition process. The survey was carried out together with Youth Organizations and community members, as shown in Figure 1.

[12] M. Gangwar and G. Kaur, "Isolation and Characterization of Endophytic Bacteria from Endorhizosphere of Sugarcane and Ryegrass," *Internet Journal of Microbiology* 7, no. 1 (2010): 10–21.

[13] S. Handayani, "Penerapan Metode Penelitian Participatory Research Appraisal dalam Penelitian Permukiman Vernakular (Permukiman Kampung Kota)," in *Prosiding Seminar Nasional Penelitian Arsitektur-Metoda dan Penerapannya*, vol. 2 (2009): 1–7.

Figure 1. Location Survey Activities Bakalan Village

Socialization

Outreach to Village residents and surrounding areas was held on Sunday, July 9 2023 at the Bakalan Village Multipurpose Building, Bululawang District, Malang Regency. The activity was attended by 17 members of the Bakalan Village Youth Organization, Village Official Representatives, and village residents. Based on the results of the activity, several questions essentially asked the public about sources of fertilizer other than animal waste. It has been stated that materials other than cow dung can be used. Apart from that, from sugar cane and corn litter but with further processing. Socialization participants confirmed whether the financing was fully borne by the PIM campus. It was conveyed that the financing was not entirely by the campus but there must be community participation by the *ABCD* (Asset Based Community Development) assistance method adopted in this activity, for example, self-help waste collection Cows volunteer to provide labor to help process the production of organic fertilizer.

Figure 2. Socialization Activities for Community Service Activities in Bakalan Village

Educational Activity

Educational activities were carried out adopting the *ABCD* (Asset Based Community Development) mentoring method, by explaining the potential of Bakalan Bululawang Village, Malang Regency, the advantages, disadvantages, and types of organic fertilizer, as well as material on the process of making PGPR biodecomposer solid organic fertilizer. Based on this educational material, solutions will be obtained to the problems faced by residents related to cow dung waste. This material provides discourse on appropriate technology and production management of rapid processing of cattle waste into organic fertilizer and marketing management of the results of the processing of making organic fertilizer. The results of the pre-test and post-test evaluation showed an increase in knowledge and understanding regarding the insight into rapid processing of organic fertilizer by 51%.

Test Production of Rapid Processing of Organic Fertilizer

The trial process is carried out in several stages, namely:

1. The manufacture of the PGPR biodecomposer starter was carried out in the Central Laboratory of Pharmacognosy at the Putra Indonesia Polytechnic in Malang. This manufacturing process was carried out over 3 days, this activity involved students because it was related to the Microbiology and SPM Laboratory Management courses.
2. Fast processing of organic fertilizer from cattle waste using the PGPR biodecomposer. The dried cow dung is crushed and sprayed with a biodecomposer starter. The spraying process is carried out simultaneously with turning over the soil and cow dung so that the fertilizer-making process becomes faster due to the aeration needed by the bacteria.

Figure 4. PGPR Spraying and Soil Turning Process

Product Analysis Test

The organic fertilizer that has been produced is tested in the PT Jadi Mas Laboratory. The results are presented in Table 1.

Table 1. Laboratory Test Results of Organic Fertilizer Production by Youth Organization BABE

Parameters	Unit	Result	Methode
Nitrogen	%	0.76	Kjeldahl
P_2O_5	%	1.52	Spectrophotometry
K_2O	%	1.71	Flame photometry
C organic	%	13.60	Furnace
Water	%	23.65	LOD-Moisture Analyzer

The results of the analysis of fertilizer products with PGPR are produced in accordance with Minister of Agriculture regulation number 70/Permentan/SR.140/10/2011 concerning organic fertilizers, biological fertilizers, and soil amendments. Conformity of laboratory results supports product quality so that product production will be carried out in increased quantities.

Production Process

Ingredients include 80 – 83% cow manure, 5% rice straw powder, 0.25% PGPR biodecomposer, 10% husk ash, and 2% lime. The processing stages include collecting cow dung (feces and urine) and draining it for one week to reduce the water content (± 60%); The drained cow dung is then mixed with organic materials such as crushed straw, husk ash, lime, and PGPR decomposer. After a week it is reversed and left for a week. In the second week, the process of turning over and spraying the PGPR biodecomposer was carried out, to speed up the decomposition process. The turning process is carried out until the fourth week to become an organic fertilizer product, then to get a uniform shape it is filtered or sifted to separate it from gravel or pieces of wood and others. While waiting for the decomposition process to complete completely, the partners make processed organic fertilizer for the next period continuously to increase productivity.

In the process of making compost, in the first trial, 10 tons of solid organic fertilizer were obtained, and then routinely every two weeks, organic fertilizer was obtained with a production capacity of 30-40 tons/month. If not applied directly to land or plants, this solid organic fertilizer product can be packaged using 25 kg plastic sacks and stored for approximately 4-6 months in dry and closed storage conditions.

Packing and Marketing

The results of the production process are packaged using sacks with a capacity of 25 kg and labeled, as shown in Figure 5a. The use of these sacks is for efficiency in storage and marketing. The initial marketing stage was carried out in Bakalan Village and its surroundings by promoting samples of solid organic fertilizer products for trials in several agricultural production communities in several papaya, cucumber, rice, and sugar cane farming communities. Furthermore, partners are developing their marketing by collaborating with several farming communities and introducing organic fertilizer products offline and online through mass media, especially to farming communities using one of the promotional media, as presented in Figure 5b.

Figure 5. PGPR Solid Organic Fertilizer Labels (a) and Promotional Leaflets (b)

Discussion

Appropriate Technology for Processing Organic Fertilizer is a technology that does not damage the environment and still produces high productivity which prioritizes food safety for the community. [14]. Greenhouse gas emissions cause global warming and have a direct and indirect impact on the agricultural system. Global warming will cause climate change, changes in rainfall patterns, and flood and drought patterns will shift which in turn will harm farming. Several technologies that have been proven to reduce Green House Gas (GHG) emissions are the use of cow waste waste into organic fertilizer. The use of organic fertilizer products on agricultural land can maintain soil fertility and is beneficial for increasing agricultural production in both quality and quantity, reducing environmental pollution, and sustainably improving land quality.

Another advantage of using organic fertilizer is that the harvest as a food product has characteristics, including being more shelf-stable, heavier, fresher, and tastier; contains hormones and vitamins for plants; saves waste management costs; reducing the volume/size of waste; has a higher selling value than the original material, and reduces air pollution. This training can provide solutions for the people of Bakalan village, Bululawang District, presented in Table 2.

Table 2. Problem Solution

No	Problem	Solution	Outcome
1.	Collection of Cattle Waste and Straw into Organic Fertilizer	- Educate farmers on how to collect livestock waste as raw material for organic fertilizer - Educate farmers and partners on how to process dry straw	Knowledge and skills of breeders, farmers, and partners on how to effectively collect raw materials for cow dung and straw
1.1	- The collection of cattle waste at the farmer is too wet - Farmers' understanding of cow dung waste drying techniques	- Education and assistance on how to collect cattle waste so that it dries quickly - Education on drying cattle waste as raw material for organic fertilizer	Farmers' knowledge and skills regarding procedures for quickly drying cattle waste as raw material for organic fertilizer
1.2	Management of collecting cattle waste for organic fertilizer processing	- Management of collecting cattle waste which will be taken to organic fertilizer processing - Management of HR arrangements in charge of collecting waste from farmers	Knowledge and Management Skills of Organic Fertilizer Processing Managers

[14] R. D. W. Rusanti, S. R. Siskayantu, E. M. Engkos, K. R. Risqi, W. H. Hariyadi, and M. R. Reza, "Penerapan Teknologi Tepat Guna Pembuatan Pupuk Organik Cair (POC) Dari Sampah Rumah Tangga di Sawangan," in *Seminar Nasional Pengabdian Masyarakat LPPM UM*, 2021.

1.3	Management Collection of dry straw from rice harvesting	Management of straw collection to be taken to organic fertilizer processing	Knowledge and Management Skills of Organic Fertilizer Processing Managers
2.	Appropriate Technology for Straw Milling	- Appropriate Technology Mentoring for efficient straw milling - Management of straw milling production	Knowledge and Management Skills of Organic Fertilizer Processing Managers
3.	Appropriate Technology for the PGPR Biodecomposer Manufacturing Process	- Appropriate Technology Assistance for Efficient Production of PGPR Biodecomposer Starter - Production management for making PGPR Biodecomposers	Knowledge and Management Skills of Organic Fertilizer Processing Managers
4.	Appropriate Technology for the Process of Mixing Cattle Waste and Straw	Appropriate Technology Mentoring for Efficient Management of Organic Fertilizer Production	Increased production capacity
4.1	Formulation Process for Rapid Processing of Cattle Waste into Organic Fertilizer	Mentoring with Appropriate Technology in the Formulation Process for Rapid Processing of Cattle Waste into Organic Fertilizer	Knowledge and Management Skills of Organic Fertilizer Processing Managers
4.2	Production Management for Rapid Processing of Cattle Waste into Organic Fertilizer	Production management for fast processing of Cattle Waste into Organic Fertilizer	Knowledge and Management Skills of Organic Fertilizer Processing Managers
5.	Quality Control Process and Organic Fertilizer Packaging	Mentoring of Appropriate Technology for Efficient Management of Organic Fertilizer Packaging	Increased packaging capacity
5.1	Organic Fertilizer Quality Control Process	Mentoring of Appropriate Technology for the Organic Fertilizer Quality Control Process	Knowledge and Management Skills of Organic Fertilizer Processing Managers
5.2	Organic Fertilizer Packaging Management	Organic Fertilizer Packaging Management	Knowledge and Management Skills of Organic Fertilizer Processing Managers

6.	Organic Fertilizer Marketing Management	- Initial marketing promotion of Organic Fertilizer using a Barter system with local farmers - Marketing management with online/offline systems - Marketing development in collaboration with related agencies	Increasing Organic Fertilizer Marketing Capacity in collaboration with farming communities

Conclusion

This Education and Assistance Program for Processing Solid Organic Fertilizer with the PGPR Biodecomposer can increase the knowledge and skills of the residents of Bakalan Village, especially the independence of the Youth Organization *BABE*, Bululawang District, Malang Regency in processing waste and support the government's program for Food Security through Local Fertilizer Self-Sufficiency.

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