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Litter Composting to Meet Fertilizer Needs for Plantation Crops in Asah Duren Village, Jembrana-Bali

I Nengah Muliarta[1*], Desak Ketut Tristiana Sukmadewi[2] , I Made Suarta[3], Ni Putu Anom Sulistiawati[4]
Prodi Agroteknologi, Fakultas Pertanian, Universitas Warmadewa
Corresponding Author: I Nengah Muliarta nengahmuliarta@gmail.com

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ABSTRACT

The community service program implemented in Asah Duren Village, Pekutatan District, Jembrana-Bali Regency aims to improve farmers' knowledge and skills in plantation litter management. Another goal is to invite farmers to start utilizing litter and processing it into compost to meet fertilizer needs. The methods used in the service program are observation, socialization, and demonstration. Based on observations, farmers in Asah Duren Village have not used litter, because they still view litter as waste material and have no benefits. Farmers after receiving socialization and training on litter utilization through the plot demonstration method have a desire to process litter into compost. Farmers also want to start using litter compost to reduce the use of inorganic fertilizers. Farmers' interest in utilizing litter compost is also increasing because the price of inorganic fertilizers is increasing.

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INTRODUCTION

Trees shed leaf litter throughout the year with varying intensities (Parzych, 2022). Plant litter, such as fallen leaves, branch cuts, and other yard debris, plays an important role in natural and man-made ecosystems. Common aesthetic perception reasons, landowners or managers of many residential park systems and urban landscaping perceive these organic residues as a burden, and therefore, are cleared from the soil and disposed of off-site (Stavi, 2020). Though leaf litter is a potential organic waste that can be recycled efficiently by composting (S. Singh et al., 2021). The fall of litter from forest trees is increasing day by day but has not been effectively utilized. Leaf litter can be turned into compost and added back to the same ecosystem to improve soil quality and tree growth (Divakar & Prasanthrajan, 2019). Leaf litter should not be sent to landfill and it should not be burned but should be composted (Kaushal & Bharti, 2015). Studies on plant litter have received a lot of attention from ecologists because they are integral factors in ecosystem dynamics, indications of productivity and affect nutrient cycles and soil fertility (Divakar & Prasanthrajan, 2019).

Processing leaf litter into organic fertilizer can provide ecological and economic benefits for companies and surrounding communities (Nurtjahyani et al., 2020). Decomposition or composting of litter organic matter in place will improve soil quality by increasing organic carbon concentrations and contributing to nutrient cycling (Stavi, 2020). Composting profitably reduces the quantity of waste and minimizes its disposal problem (S. Singh et al., 2021). Litter decomposition will produce compost or stable products such as humus resulting from the biological decomposition process of organic matter under controlled conditions. Compost is a rich source of vitamins, hormones, enzymes, and macro and micro nutrients which when applied to plants help in efficient growth (Hilty & Prabha, 2015). The application of compost has previously been proposed as a soil amendment capable of slowing nutrients lost through surface runoff, thereby stimulating the rate of infiltration (Anwar et al., 2012). The quality of compost resulting from leaf litter degradation by microorganisms is an effective biofertilizer that will facilitate increased nutrient absorption by plants resulting in higher growth and yield (Hilty & Prabha, 2015).

Litter removal reduces the rate of leaf litter decomposition, which in turn can affect nutrient cycling and negatively impact plant growth. Plantation farmers tend not to use or process the resulting litter into compost. Moreover, to support the fulfillment of fertilizers for plantation crops, farmers prefer to use inorganic fertilizers, as done by the Amerta Masa Farmer Group, Asah Duren Village, Pekutatan District, Jembrana. Asah Duren Village is one of the villages producing coconut, banana cloves, and durian. Asah Duren is one of 8 (eight) villages located in Pekutatan District, Jembrana Regency, Bali Province. The area of Asahduren Village is 6.13 km^2 or about 4.73% of the area of Pekutatan District and 0.73% of the total area of Jembrana Regency. The people of Asah Duren Village mostly make a basic livelihood as farmers. The total population in Asah Duren Village consists of 892 households, consisting of 1882 men and 1830 women. Asah Duren Village is divided into 4 hamlets namely More Hamlet, Asahduren Hamlet, Temukus Hamlet, and Segah Hamlet.

The problem is that garden farmers in Asah Duren Village do not know how to process litter into compost. Farmers need innovation in composting plantation litter, to be able to produce compost quickly, easily, and with quality. Based on these needs, farmers in Asah Duren Village asked for socialization and training in making compost made from plantation-based plant litter. Composting training, in addition to being able to assist in managing plantation litter, is also expected to have an impact on reducing the use of inorganic fertilizers.

IMPLEMENTATION AND METHODS

Service activities were carried out by involving partners of the Amerta Masa Farmer Group, Asah Duren Village, Pekutatan District, Jembrana Regency Bali. The final target of the service activity is to increase the knowledge and skills of partners, especially members of farmer groups in managing plantation litter. The farmer group members involved have the understanding and ability to carry out the litter composting process in a simple way and at a low cost. To achieve this target, litter composting techniques are provided with fast, practical, and cheap pins. Litter composting is an alternative for farmers in meeting fertilizer needs and as a strategy for reducing the use of inorganic fertilizers. The processing of plantation litter as compost is also an effort to implement the concept of low external input sustainable agriculture (LEISA).

The methods used in this community service activity include observation, socialization, and plot demonstration methods. Service activities start from the end of May to early July 2023. The composting technique that is socialized to farmers in service activities is composting with aerobic methods. Aerobic composting was chosen because it is more practical and in line with climate change mitigation efforts.

Observation

Observations were made at the initial stage of the activity as an effort to determine the habits of farmers in Asah Duren Village in managing plantation litter. The observation method is a tool to understand farmers' behavior and perceptions of plantation litter. According to Walshe et al (2012), conservation provides opportunities for researchers to understand people's actions, roles, and behaviors. Ekka (2021) stated that observation is a technique for researchers to collect data. This technique allows researchers to use the senses, and reflexivity as a benchmark to obtain information and know social phenomena that occur. Observations can be integrated as additional data and one of the strategies to corroborate research findings (Jamshed, 2014). The results play a role in the development of theories, concepts, and explanations of social processes. In particular, it contributes to understanding structure (Walshe et al., 2012).

Socialization

Socialization is one of the important methods in efforts to transfer knowledge related to litter management theory, ranging from litter collection, site selection to litter composting techniques and the use of litter compost for plantation plants. The socialization was held at the Village Hall, Asah Duren Village on Monday, July 10, 2023. Socialization is a means for farmers in partners to understand the importance of litter utilization and the role of litter compost in supporting plantation growth and production. According to Amanah (2017), socialization is often synonymous with delivering information, although it can be interpreted as a transfer of knowledge. Socialization is also often associated with the science of human behavior as part of a social system.

Plot Demonstration

After the socialization process, it continued with plot demonstration activities to deepen the understanding of partners. This effort becomes a strategy in an effort to deepen the theory, where participants will learn about the process or action in litter composting experiments. Demonstration plots were carried out to accelerate the adoption of litter composting technology, as well as train farmers' skills. Sseguya et al. (2021) stated that plot demonstrations are an effective way to increase technology adoption. Plot demonstration activities are carried out in an effort to motivate farmers to be able to implement or implement the theories obtained in daily practice.

Monitoring and evaluation

Monitoring and evaluation are carried out as a step in ensuring activities are run by the plan that has been set. The stages of monitoring and evaluation activities start with preparation, planning, and implementation activities. The results of monitoring and evaluation activities become valuable information that can be used as a guide in evaluating activities and making changes for further improvement of activities. Monitoring becomes part of ongoing analysis and compares with established plans to assess against a given intervention. While the evaluation aims to explore information that can be guided to identify the best way to get the desired results.

RESULTS AND DISCUSSION

The community service program held in Asah Duren Village, Pekutatan District, Jembrana involved 20 participants. Participants are members of the Amerta Masa Farmer Group who on average have been farming for more than 20 years. Overall, the members of the Amerta Masa Farmer Group are men. It is suspected that this is related to the custom in Indonesia that men are the head of the family and breadwinners. While women play a more role as housewives who take care of children and help the head of the family. This analysis is in line with the statement of Mulugeta, & Amsalu (2014), which states that most rural women have no role in decision-making related to the purchase, or sale of agricultural equipment, land preparation, and determination of the type and amount of chemicals (pesticides, herbicides) used. The participation of village women in making decisions on farm management is very minimal. While Ochieng et al.

(2014) stated that agricultural cultivation managed by women is much less intensive than agriculture managed by men, due to the limited ability of women to obtain technological inputs such as fertilizers and superior seeds.

Field conditions show that women are more responsible for household matters, ranging from preparing food, taking care of children, and cleaning matters of the house. Related to agricultural management, women tend to only help work. This is in line with the opinion of Howland et al (2019) which states that women are generally responsible for food security in the household, but at the same time become victims of food insecurity and malnutrition. Women spend more time than men on household chores (Doss, 2018). Women are powerless when it comes to participating, influencing, and having autonomy over decisions about agricultural activities and income from the sale of crops (Peralta, 2022).

Litter Management by Farmers

Farmers in Asah Duren Village have never used the litter on the plantation, and there is even a habit of burning litter. Burning litter is carried out by farmers on the grounds of cleaning the garden. Farmers still view litter as waste or unnecessary garden waste. This condition is the same as the view of Ungureanu et al. (2017) which states that farmers generally do not handle waste properly which ultimately has an impact on greater environmental damage. Farmers in Karanganyar, for example, handle agricultural waste by burning (Dharmawan et al., 2023). Farmers burn agricultural waste because based on hereditary knowledge it is believed that burning is fast returning agricultural waste to the ground (Muliarta et al., 2023). Burning is a serious threat to climate, soil fertility, human health and well-being, and air quality, increasing mortality and decreasing agricultural productivity (Singh et al., 2022). Agricultural waste treatment plays an important role in the sustainability of agricultural production and the welfare of rural communities (Xu et al., 2023). Farmers need simple solutions so it becomes important to promote residue management practices that should have an economic value component for farmers and also have sound financial viability. Farmers need in situ solutions that can solve residue problems in a short time frame of 10-15 days (Singh et al., 2022).

Farmers in Asah Duren Village admitted that they had never recycled garden waste in the form of litter. Farmers need practical, efficient, and fast garden waste treatment innovations. Aramyan et al. (2021) stated that various types of innovations have a high potential in reducing and preventing waste generation. However, they still need to be economically viable for adoption by farmers or decision-makers. The innovation of recycling from agricultural solid waste into useful products can generate other collections of agricultural solid waste, which can serve as raw materials for other useful products, thus requiring continuous recycling of agricultural solid waste until each potential waste is converted into wealth (Adejumo & Adebiyi, 2020).

Farmers recognize the need for knowledge and skills in processing garden litter into products that can be useful or of economic value. Moreover, so far farmers have never compressed socialization related to the utilization or processing of plantation litter. Muliarta et al. (2023) stated that limited knowledge about the benefits of agricultural waste for soil fertility causes farmers to tend to burn the agricultural waste produced. The level of education on the other hand also has a significant influence on farmers' knowledge about waste management (Muatip et al., 2022). In the future, there is a need for programs to increase farmer awareness and new orientation of farmers in implementing environmentally friendly agricultural practices (Gebska et al., 2020).

Plantation Litter Composting

Farmers in Asah Duren Village admitted that they had never composted plantation litter. The reason is because they do not know how to compost and do not have adequate composting equipment. Viaene et al. (2016) and Muliarta (2019) stated that a lack of knowledge and experience is an inhibiting factor in efforts to compost agricultural or plantation waste by farmers. Limited knowledge and how to make compost causes farmers to need composting assistance through making demonstration plots (Muliarta et al., 2023). Complicated and labor-intensive procedures in making compost are one of the factors causing farmers to have difficulty in making compost (Supaporn et al., 2013). The existing obstacles cause farmers who do compost to be limited, despite knowing the benefits of composting (Fayama, 2022). Composting is an ecological method of recycling organic waste. It presents an effective solution to reduce large volumes of agricultural waste and provide organic fertilizers and soil improvers (Majbar et al., 2021). Composting is the most adaptable and beneficial method for managing biodegradable solid waste; it is an important agricultural practice that contributes to the recycling of agricultural and agricultural waste (Waqas et al., 2023). Compost production will contribute to environmental sustainability and the promotion of ecological management of agricultural waste that meets circular economy requirements (Majbar et al., 2021). Composting has advantages over other practices, such as landfilling agricultural waste, which increases the potential for groundwater pollution by leachate while composting reduces water pollution (Waqas et al., 2023).

The availability of composting sites is another challenge that causes farmers in Asah Duren Village to not do composting. Farmers are of the view that the provision of composting stations requires capital and time. This is why during composting training, farmers are advised to do composting on the spot, without a special place. This recommendation is an effort to present a practical and economical composting process. Composting in the middle of the plantation can be done by making mounds so that when it rains compost is not submerged. The composting place is made of bamboo resembling a fence that forms a box with a length of 1.5 meters, a width of 1 meter, and a height of 1 meter. The top of the mound of compost material is stacked to a height of 1 meter. The top of the compost material pile is covered with tarpaulin or plastic to reduce evaporation.

Although they have never done composting, farmers in Asah Duren Village commit to using litter as compost in the future. The composting delivered to farmers in Asah Duren Village is composting using the aerobic method (Figure 1). The aerobic method is quite practical because it does not require a special place and is adaptive to climate change mitigation policies. The aerobic method is in line with climate change mitigation because it does not produce methane gas emissions and unpleasant odors. According to Huang et al. (2017), aerobic composting is easy to operate and easy to manage at a low cost. Aerobic composting also proceeds quickly because it involves the help of oxygen, in contrast to anaerobic composting which produces a foul odor due to the presence of various forms of bacteria and the release of various substances during decomposition (Mckenzie et al., 2022).

Figure 1. Demonstration of Plantation Litter Composting Plot By Aerobic Method

Composting training is provided to farmers using natural decomposers in the form of goat manure. The use of goat manure as a decomposer is an effort to provide composting at a low cost because if you use a commercial decomposer farmers have to incur additional costs. Goat droppings in principle also already contain microbes that can decompose. Moreover, the addition of commercial decomposers does not necessarily provide a positive effect or acceleration of composting. According to Mitri & Foster (2013), the addition of microbial composition or a single microorganism can have a positive, negative, or neutral response with other microorganisms present on the same material. Commercial decomposers are not needed in composting, because naturally microbes present on the surface of materials, can degrade organic matter (Rishell, 2013).

The litter composting demonstrated to farmers in Asah Duren Village was not accompanied by enumeration treatment. Enumeration is not done to give farmers the impression that litter composting can be done practically. The results of previous studies showed that enumeration did not provide different compost ripeness. Enumeration treatment only accelerates the decomposition process at an early stage (Muliarta et al., 2019). Some theories say that the smaller the size of the material, the faster its biological degradation. The size of the material that is too small also limits the entry space for oxygen, causing a slow decomposition process (Atalia et al., 2015). According to the theory the oxygen in the compost

pile should not be lower than 5% and composting becomes optimal at the level of oxygen availability reaching 10% (Román et al., 2015). Composting aeration in a demonstration of the plot using passive aeration with a one-time reversal in 7 days. Too frequent reversals will also make farmers lazy to do composting because it will require additional labor. Previous research proved that turning compost once every 6 or 7 days in composting rice straw aerobically will produce mature compost within 30-35 days. A more routine reversal frequency tends to disrupt the decomposition process and does not provide a more mature compost maturity (Muliarta, 2016; Muliarta & Suanda, 2020).

Farmers Still Hesitant to Use Compost

Based on the results of interviews with farmers, it was revealed that farmers are still hesitant to use compost for fertilizing plantation plants. Farmers have been very dependent on inorganic fertilizers, especially for fertilizing fruit crops. Liu et al (2022) stated different litters contribute differently to soil nutrition; return nutrients, maintain fertility, and in general encourage the ecological development of the garden. Most farmers are not aware of the effectiveness of compost, and it is often considered an inefficient product compared to inorganic fertilizers (Majbar et al., 2021). Farmers argue that the use of compost does not necessarily provide an increase in production. Common conditions of compost use cause a decrease in production and the amount of compost required is also quite a lot. Sánchez et al. (2017) stated that the use of compost in agriculture is constrained because it takes a long time to see the results and mineralization takes place slowly so that the supply of nutrients to plants decreases. The adoption of compost on the other hand also varies when viewed from the cropping system and the characteristics of farmers. Farmer experience and farmer education level positively influence the adoption of compost use (Paul et al., 2017). Government subsidies are indispensable to implement composting programs and efforts to increase the use of compost (Zhou et al., 2018).

Composting and recycling have a positive impact on resource management and agricultural resilience and contribute to achieving sustainability goals (Fendel et al., 2022). The use of ever-increasing doses of compost turned out to be beneficial for the physiological, productive, and quality parameters of the crop. An increase in the dose of compost on the other hand results in an increase in organic matter in the soil and soil nutrient content (Pinto-Morales et al., 2022). Compost can have a variety of values, depending on the cropping system applied, and the application rate used (Hills et al., 2019). Farmers are aware of the role of compost in maintaining yields and improving soil quality. However, the lack of adequate equipment and organic matter to make compost, land tenure, and the intensive labor required to compost are major obstacles to the application of compost technology (Ouédraogo et al., 2021).

Monitoring and Evaluation

Monitoring and evaluation are carried out from the beginning to the end of the activity, to determine the reaction and changes of partners to the activities carried out. Monitoring and evaluation are carried out since the socialization activity to find out the understanding of partners on the knowledge transfer provided. Through monitoring and evaluation, farmers' awareness and knowledge of plantation litter management and its ability to convert it into compost has been observed (Table 1).

Table 1. Partner Response

Partner Perception	Before socialization and demonstration of plots	After socialization and demonstration of the plot
Litter management	Farmers tend to leave litter and burn on the grounds of cleaning the garden	There is an effort to collect litter and a desire to do litter composting
Litter composting motivation	Farmers have never composted because they do not know how to compost litter	Commit to composting because you know how to compost
Perception of litter composting	Litter composting is complicated, requiring composting time and place	Composting can be done simply, quickly, practically and done in the garden
Benefits of processing litter into compost	Does not provide additional benefits	Reduce the use of inorganic fertilizers and reduce the cost of purchasing fertilizers

The implementation of community service programs at the Amerta Masa Farmer Group, Asah Duren Village, Jembrana-Bali has generally changed views and provided knowledge to farmers in managing the plantation litter they produce. Some farmers began to practice composting made from garden litter. There is a desire to start using compost from litter to reduce the use of inorganic fertilizers, which are starting to rise in price and are difficult to buy. Farmers have realized that burning litter in addition to disposing of raw materials for composting also contributes to air pollution which has an impact on increasing greenhouse gas emissions.

CONCLUSIONS AND RECOMMENDATIONS

Litter generally has not been utilized by farmers because it is considered waste material and has no benefit. Litter is also sometimes burned when farmers clean up gardens because burning is the most practical and fast way of clearing litter from plantations. Litter tends to be burned because farmers do not know how to use litter, including processing litter into compost. Farmers after receiving socialization and training on litter utilization through the demplot method have the desire to process litter into compost. Some farmers start trying to do

composting in a practical, simple, and cheap way, especially after knowing that the composting process does not require a special place and can be done in the garden. Farmers on the other hand want to start utilizing litter compost to reduce the use of inorganic fertilizers. Farmers' interest in utilizing litter compost is also increasing because the price of inorganic fertilizers is increasing. Farmers' interest in using fertilizer increases along with understanding and knowledge about the benefits of compost for soil fertility and health.

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