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Management of fishery waste into liquid organic fertilizer in Hamadi Jayapura

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ABSTRACT

Fishery waste is a problem that is very disturbing to the community because it causes strong odors, dirty views, and reduces water quality. Apart from having a negative impact, fishery waste still contains components needed for plant growth, such as nitrogen (N), phosphorus (P), and potassium (K). Therefore, it is essential to conduct community service activities for POKBAKER that involve the conversion of fishery waste into liquid organic fertilizer (POC). The aim of carrying out service activities is to provide understanding to participants through lectures and practical activities in making fertilizer from fisheries. The implementation methods expressed are three, namely pre-preparation, socialization activities (pre-test, lecture, post-test), and practical activities. The materials used in practical activities are fishery waste (gills and offal), EM4, molasses, and rice washing water. The results show that the percentage of answers to the six pre-test questions given ranges from 53-100 percent, while the percentage of the eight post-test questions given ranges from 93-100 percent. So, the conclusion is that this activity can increase the knowledge and understanding of the Fishery Waste Processing Group (POKBAPER) from 53 percent to 90 percent. Participants have the ability to plant liquid organic fertilizer from fishery waste.

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1. INTRODUCTION

Fishery waste refers to the residue from fishing activities or businesses, categorized into three types: solid waste, liquid waste, and gaseous waste. The waste produced causes environmental pollution problems, such as water pollution resulting from waste being discharged into bodies of water or the sea. This pollution impacts organisms or biota in the water due to declining water quality, unsightly views, and foul odors (Hamuna et al., 2018). Examples of fishery waste include bones, fins, heads, scales, entrails, and others. This waste constitutes 30-40 percent of the total fish weight, comprising the head (12.0 percent), bones (11.7 percent), fins (3.4 percent), skin (4.0 percent), spines (2.0 percent), and entrails (4.8 percent) (Yogya Pos, 2020).

Liquid fishery waste has significant potential to be utilized as liquid organic fertilizer (LOF). This utilization is essential not only for environmental sustainability but also for supporting the community's economy. LOF is defined as a liquid containing various easily soluble nutrients that meet plant needs, ensuring more even nutrient distribution (Istiqomah et al., 2016; Solihin et al., 2019). Processing waste

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into LOF also helps farmers maintain their crops (Agustina et al., 2021) and provides economic benefits to fish sellers or fishermen, as waste can be optimally utilized to achieve a zero-waste concept.

According to Mulyono et al. (2023), processing fishery waste into LOF is typically conducted through anaerobic or semi-aerobic fermentation. This process produces fertilizer rich in micronutrients such as phosphorus, nitrogen, and potassium, which are crucial for plants. Fermentation involves microbes that produce specific enzymes, making microbial starters key to accelerating decomposition and enhancing fertilizer quality (Meriatna et al., 2019; Rahmadina, 2019). Activators like EM4 and acetic acid also play an essential role in speeding up decomposition, enabling the production of efficient, high-quality LOF.

At the Hamadi Fish Landing Base (PPI Hamadi), there is abundant fish waste production. This waste is not managed properly and is directly disposed of into the sea, indicating that as landing and fish-selling activities at Hamadi Market increase, so does the amount of waste generated. Therefore, community service activities are necessary to provide information to the public, particularly fish sellers, about how to utilize fishery waste into value-added products.

One of the main challenges in managing fishery waste is the low awareness and knowledge of the community regarding the importance of waste management and their limited understanding of the concepts and techniques involved. Yet, fishery waste can be processed into various useful products. With proper management, waste that has previously troubled communities can be productively utilized and no longer disposed of into the sea.

The aim of this activity is to provide participants with an understanding through the delivery of material and direct practice on the stages of processing fishery waste into liquid organic fertilizer. It is hoped that this can become a tangible solution in reducing waste and adding value to the community.

2. METHODS

This community service activity was held on July 20, 2024, starting at 10:00 AM until completion, in Hamadi Village, Jayapura. The target audience for this activity was groups of women and young female fish sellers at Hamadi Market who were interested in participating, leading to the formation of the Fishery Waste Management Group (POKBAPER). The number of partners involved was 15 people, with a team of 5 facilitators. The establishment of the POKBAPER group reflects concern for the environment at Hamadi Market. The proposed solution involved socialization and assistance in managing fishery waste into Liquid Organic Fertilizer (LOF).

The methods used in this community service activity included lectures, discussions, and practical exercises. Additionally, to assess the community's knowledge improvement during the training (transfer of knowledge, technology, and arts from the facilitators to the participants), a pre-test and post-test control group design was employed. The pre-test was conducted at the beginning before the material presentation, and the post-test was conducted at the end of the activity.

Preparation

The preparation activities began with the collection of initial information in April, prior to submitting the community service proposal for funding. The purpose of this information gathering was to assess the waste conditions at Hamadi Market, which had become a concern for the community. During the initial survey and discussions with several women and young female fish sellers, the purpose of the activity was explained. The discussions received positive responses from the women and young sellers, leading to the formation of POKBAPER as the target partner group. After the group was established, the community service team proceeded with setting objectives, formulating plans, and organizing the implementation of the activities.

Socialization

The socialization activities in this community service program included: (1) Preparation of materials; (2) Conducting a pre-test; (3) Distribution of printed materials; (4) Lectures/presentation of materials; (5) Discussions and Q&A sessions; and (6) Conducting a post-test. The results of the pre-test and post-test were used as indicators to measure participants' understanding of the socialization materials.

Practice

The practical activity began with the following stages: (1) Preparation of tools and materials necessary for processing fishery waste into liquid organic fertilizer; (2) Selection of a strategic practice location to allow participants to easily observe, ask questions, discuss, and engage in hands-on practice; (3) Practice execution, involving all participants without exception.

The fishery waste used was sourced from Hamadi Market, Jayapura, collected the day before the activity on July 19, 2024, at 4:00 PM WIT. The types of fish waste used were gills and entrails, with a total weight of 5 kg. The waste was processed using a chopper machine until finely ground and then stored in a refrigerator for use the next day. Additional materials for making liquid organic fertilizer included EM4, molasses, and rice washing water. Processing Procedure: (1) Add 5 kg of fish waste to a bucket; (2) Pour in 3 liters of Agricultural EM4 (equivalent to 3 bottles); (3) Add 3 liters of molasses to the mixture; (4) Add 30 liters of rice washing water, then stir until evenly mixed. Once all ingredients were thoroughly combined, the liquid fertilizer was poured into 2-liter bottles, labeled with stickers, and fermented for 15 days before being ready for use.

3. RESULTS AND DISCUSSION

Results

Partner identification

Hamadi is located in the coastal area of Jayapura City and has significant fishery potential, supported by the presence of the Fish Landing Base (PPI) and the Fish Auction Place (TPI) (DKP Provinsi Papua, 2021). TPI, as part of PPI Hamadi, functions to increase economic value through facilities supporting fishing activities.

Hamadi Market is the main trade center in Jayapura City, located about three kilometers south of the city center. With a significant fish production volume, including 1,586,143 kg of skipjack tuna and 772,985 kg of yellowfin tuna, this increase in fishery output also generates waste such as bones, skin, fins, heads, scales, entrails, and liquids that pollute the environment and produce unpleasant odors. Fish vendors at Hamadi Market come from various ethnic groups, including fishermen selling their direct catches and retail fish traders. These retailers play an important role in promoting fishery products to consumers. Currently, there are around 103 retail fish traders at PPI Hamadi, Jayapura.

The target group for this community service activity consists of women or young female fish sellers at Hamadi Market who are concerned about the surrounding environment. This group, known as POKBAPER (Fishery Waste Management Group), was formed in April 2024 to support sustainable fishery waste management.

This community service activity was attended by 15 participants who found the activity interesting because the bothersome waste could be processed into organic fertilizer. The participants' age range varied from 19 to 54 years, with the highest level of education being high school (Figure 1).

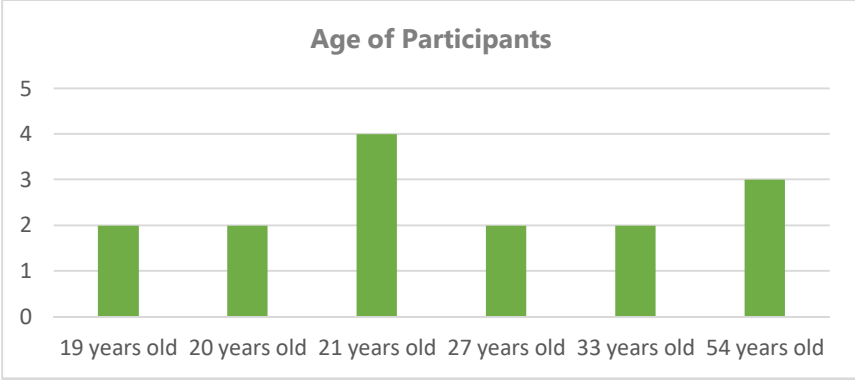

Figure 1. Age data of community service activity participants

Socialization

Before the presentation by the speaker/instructor, a pre-test was conducted to assess the participants' initial understanding before the material was presented. The pre-test lasted for 15 minutes. After the pre-test, printed materials were distributed to the participants. The pre-test and distribution of materials are shown in Figure 2. The results of the pre-test can be seen in Table 1.

Figure 2. Implementation of pre-test and distribution of materials

Table 1. Analysis of participant pre-test results

Questions	Answers			
	Yes	%	No	%
Do you know the types of fishery waste?	2	13	13	87
Do you know how to process fishery waste?	0	0	15	100
Do you know the composition of liquid fertilizer?	0	0	15	100
Do you know that fish waste can be processed into liquid fertilizer?	5	33	10	67
Are you interested in processing fish waste into liquid fertilizer?	13	87	2	13
Do you know the impact of fish waste?	8	53	7	47

The materials presented in this activity include general understanding of waste, grouping of types of waste, sources of fishery waste, negative impacts of fishery waste, management of fishery waste, reasons why fishery waste is processed into liquid organic fertilizer. The delivery of the material was carried out slowly so that it was easy for participants to understand. The delivery of the material lasted for 2 hours, which was then continued with a question and answer session (Figure 3).

Similar to the pre-test, the post-test was also conducted to determine the increase in knowledge of the participants. The post-test activity was carried out for 20 minutes. The implementation of the post-test can be seen in Figure 4 and the results of the post-test analysis can be seen in Table 2.



Figure 3. Delivery of material and question and answer session
Figure 4. Implementation of post-test

Table 2. Analysis of participants' post-test results

Questions	Answers			
	Yes	%	No	%
Do you know the types of fishery waste?	14	93	1	7
Do you know how to process fishery waste?	14	93	1	7
Do you know the composition of liquid fertilizer?	15	100	0	0
Do you know that fish waste can be processed into liquid fertilizer?	15	100	0	0
Are you interested in processing fish waste into liquid fertilizer?	15	100	0	0
Do you know the impact of fish waste?	15	100	0	0
Does processing fish waste into fertilizer provide benefits for you?	15	100	0	0
Is the technique of processing fish waste into liquid fertilizer easy to practice/do?	15	100	0	0

Assistance in the practice of managing fishery waste into liquid fertilizer

The community service activity of assisting in the practice of managing fishery waste into liquid organic fertilizer began with the preparation of tools and materials used in the implementation of the practice. The tools used in the implementation of the practice activities were buckets, chopper machines, stirrers, funnels, measuring cups, and 2-liter bottles. The materials used in the implementation of the practice activities were fishery waste (gills and offal), EM4, molasses, rice washing water, and stickers. Before the practice activities, participants were given a brief explanation of the stages in making liquid organic fertilizer from fishery waste (Figure 5) and the stages that had been carried out by the participants can be seen in Figure 6.

Discussion

The analysis results from the pre-test showed that 87 percent of participants did not know the types of waste; 100 percent of participants did not know how to process fishery waste; 100 percent of participants did not know the composition of liquid fertilizer; 67 percent of participants knew that fishery waste could be processed into liquid fertilizer; 87 percent of participants were interested in processing fishery waste into liquid fertilizer; and 53 percent of participants knew the impacts of fish waste. The pre-test was given before the teaching began to assess the participants' initial understanding.

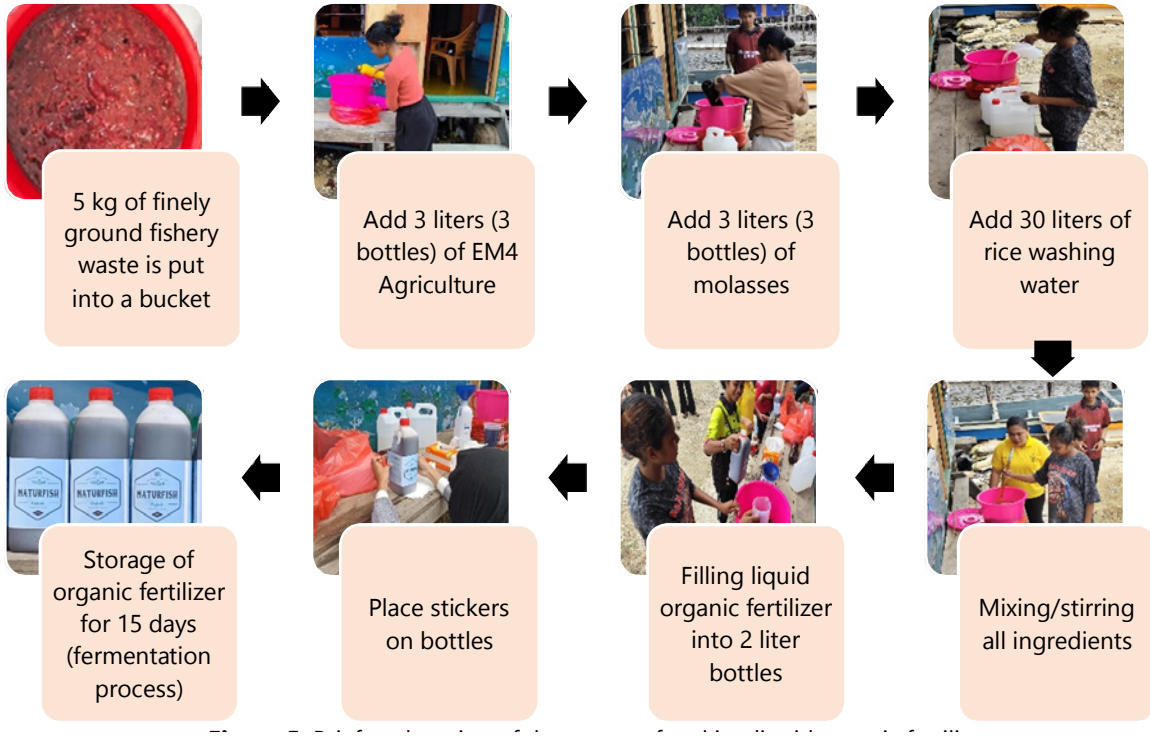

Figure 5. Brief explanation of the stages of making liquid organic fertilizer
Figure 6. Flow of fertilizer making practice by participants

Socialization is a process where individuals can provide responses and reactions. The purpose of the socialization activity was to educate the community in order to raise awareness and knowledge about the importance of not dumping waste into the sea and to educate the use of fishery waste as something with added value. The community service activity began with material presentation by the speaker and was followed by a discussion. This activity aimed to enhance the participants' soft skills. The materials presented during this activity included general knowledge about waste, classification of types of waste, sources of fishery waste, the negative impacts of fishery waste, waste management, and the reasons for processing fishery waste into liquid organic fertilizer.

The discussion method involved exchanging information, opinions, and experiences in a structured way to gain a clearer and more accurate understanding of the subject. The question-and-answer method was used to gather questions or feedback about the material presented. This method aimed to help participants understand the knowledge about fishery waste. After the lecture, the speaker opened the

session for discussion and questions, allowing the participants to ask questions related to the material. During the discussion and Q&A session, participants were very enthusiastic, and many questions were raised.

The post-test analysis showed that 93 percent of participants did not know the types of waste; 93 percent knew how to process fishery waste; 100 percent knew the composition of liquid fertilizer; 100 percent knew that fishery waste could be processed into liquid fertilizer; 100 percent were interested in processing fishery waste into liquid fertilizer; 100 percent knew the impacts of fish waste; 100 percent believed processing fish waste into fertilizer was beneficial; and 100 percent thought processing waste into liquid fertilizer was easy to practice. These results indicate an increase in the participants' knowledge and understanding of fishery waste management, especially converting it into liquid organic fertilizer. The increase in participants' understanding shows that the community service activity was successful because the participants understood the material and could apply the knowledge directly. These results align with other community service activities where material comprehension showed a high percentage of 95 percent (Mulyani et al., 2022).

Fishery waste can come from parts of the fish such as scales, bones, fins, blood, production leftovers, and fish entrails (Bapang & Widyarini, 2023). Fish waste also includes fish that are not used due to decreased freshness or quality, making them economically worthless (Grasela et al., 2022). Since fish waste originates from by-products of fish processing, it has a negative environmental impact, such as pollution (Chinh et al., 2019).

The potential of fisheries can be maximized by utilizing fishery waste that is discarded and economically worthless, but this waste can provide added value, one of which is by processing it into liquid fertilizer. Fishery waste can be processed into liquid fertilizer because it still contains a lot of protein and fat, which causes high levels of nitrates and ammonia (Astuti, 2014). Fertilizers made from fishery waste can increase plant resistance to pathogens (Tiwow et al., 2019).

Organic fertilizer is the result of the decomposition of organic materials by microorganisms, and it is absorbed more quickly than inorganic fertilizers (Sharma & Chetani, 2017), while also suppressing plant diseases, thus ensuring that plant nutrient needs are met (Rahmawati et al., 2023). The types of organic fertilizers commonly found on the market are liquid and solid fertilizers. The fertilizer made in this activity is liquid fertilizer. Liquid fertilizer has advantages over solid fertilizers, such as providing nutrients according to plant needs, more uniform application, and adjustable concentration. Therefore, liquid organic fertilizer has a high absorption rate and contains macro-nutrients (phosphorus, nitrogen, potassium) and micro-nutrients (Mulyono et al., 2023). The production of liquid fertilizer depends on the raw materials, decomposing microorganisms, manufacturing process, final product, and packaging (Sanghani, 2014).

During the practice of making the fertilizer, a process of grinding the waste was conducted. The purpose of grinding was to reduce the size of the waste, which makes it easier for microorganisms to decompose (Nur et al., 2016). Other materials used in making liquid organic fertilizer from fishery waste include EM4, molasses, and rice washing water. Effective Microorganism 4 (EM4) is a bioactivator commonly used to speed up the decomposition of organic materials from 3 months to 7-14 days. The EM4 product used is EM4 for Agriculture, which contains microorganisms that ferment organic materials in the soil, as well as nourishing plants and improving soil health. These microorganisms include lactic acid bacteria (Lactobacillus sp.) and fermentation fungi (Saccharomyces sp.). The process of speeding up composting with the help of EM4 can occur semi-an aerobically, eliminating odor, and the success rate of fermentation depends on the environmental conditions in which the bacteria live (Nur et al., 2016). Molasses is a by-product of sugarcane juice that is brownish and dark black in color (Suprayogi et al., 2022). Dark molasses contains a high sugar content (50 percent). Molasses contains 50-65 percent sugar

(Rochani et al., 2015). Based on its content, molasses serves as a carbon source that bacteria use for growth in the anaerobic decomposition of organic material (Zi et al., 2022). Rice washing water is a plant growth stimulant because it contains carbohydrates, nitrogen, phosphorus, potassium, magnesium, sulfur, iron, and vitamin B1 (Hairuddin et al., 2019; Novianti et al., 2022; Wardiah et al., 2014). Due to these compounds in rice washing water, it can stimulate growth and root metabolism (Rafidah et al., 2023), increase fruit weight (Yulianingsih, 2017), and stimulate leaf growth (Hairuddin, 2019).

4. CONCLUSION AND RECOMMENDATIONS

This activity has successfully increased the knowledge and understanding of the Fishery Waste Processing Group (POKBAPER) and other participants who are also committed to environmental preservation. The improvement in understanding and knowledge is evidenced by the pre-test and post-test analysis results. The pre-test was conducted at the beginning of the session before the material was presented, consisting of six questions. The percentage of correct answers to these six questions ranged from 53 percent to 100 percent. The post-test, conducted at the end of the activity after the presentation and practice, consisted of eight questions. The percentage of correct answers for the post-test ranged from 93 percent to 100 percent. These results indicate an improvement in the understanding of the POKBAPER members and other participants, with the percentage increasing from 53 percent to 90 percent. Participants demonstrated the ability to practice the making of liquid organic fertilizer from fishery waste. Due to the high enthusiasm of the participants, the attendance level was also high, with participants practicing the fertilizer-making process in rotation. The practice included the preparation of ground waste, adding EM4, molasses, rice washing water, measuring waste into 2-liter bottles, and labeling the bottles.

While participant enthusiasm was high, the limited tools and materials required the practice to be conducted in turns, which may have left some participants feeling they did not have enough hands-on experience. To address this, additional tools and materials should be provided so that all participants can practice simultaneously. The community service activity only covered the stage of producing the liquid organic fertilizer, so further steps are needed, such as applying the liquid fertilizer to plants, conducting financial analysis, and exploring the production of solid fertilizer from fishery waste.

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