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Improving the Quality and marketing of organic fertilizer with the addition of KPDS in Sorong Regency

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ABSTRACT

Agricultural land in Papua suffers from a deficiency of macro-nutrients essential for plant growth. This shortfall is attributed to the prevalence of utisol soil types, which make up 49.21% of the total land area. However, by implementing suitable processing technologies and innovative practices, livestock waste can be transformed into a high-value product. The innovative processing of livestock waste into fertilizer has the potential to enhance soil structure and fulfill the nutritional needs of plants. The Tunas Siaga Livestock Farmer Group and the Tunas Bangsa Youth Organization, facing challenges in the production and marketing of livestock waste products, have been identified as the target partners for this initiative. A field observation study revealed that only 20% of the total livestock waste is currently utilized for composting. The proposed solution involves using livestock waste, supplemented by natural phosphate, to improve product marketability, quality, and quantity. To achieve this goal, a comprehensive training program will be initiated, consisting of the following components: (1) training on processing livestock waste into solid and liquid organic fertilizers, enhanced by Krandalite Phosphate Deposited Soil (KPDS); (2) training in product packaging and marketing. The training program will be delivered through a combination of digital and traditional marketing channels. The effectiveness of this initiative will be assessed through a pretest and posttest administered to participants during the activities. Evaluation results indicate that the innovation involving the inclusion of KPDS in solid and liquid organic fertilizers is likely to be well-received by the target partners. Additionally, evaluation findings demonstrated that most participants experienced a significant increase in knowledge and skills in livestock waste management, with an overall improvement of 64.4%. This increase was evident in the pretest and posttest results, which showed an average score improvement among participants.

KEYWORDS
Livestock waste
Organic fertilizer
Products
Sorong
Phosphate soil

1. Introduction

The agricultural development of Papua is still hindered by the absence of adequate infrastructure and production materials, which is attributable to the high cost of construction and transportation. According to data from the Central Statistics Agency (BPS) in 2023, West Papua Daya recorded 121.87 points, making it the region with the sixth highest construction cost. The provincial government has identified high poverty rates in Papua, particularly in southwest Papua, which encompasses six areas with particularly high poverty rates: Tambrauw Regency, Raja Ampat Regency, Maybrat Regency, South Sorong Regency,

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Sorong Regency, and Sorong City. Sorong Regency, classified as an underdeveloped, leading, and outermost (3T) area, exhibits considerable potential for the development of livestock. The Ministry of Agriculture (Kementan) has expressed support for the development of livestock and plantation potential in various regions, including southwest Papua province. To this end, the Ministry of Agriculture is collaborating with local governments to enhance the effectiveness of the livestock and plantation subsector.

In general, agricultural land in Papua exhibits a deficiency of macro nutrients that are critical for plant growth, attributable to the prevalence of ultisol soil types, which account for approximately 49.21% of the total soil types in the region [1]. This particular soil type, classified as ultisol, is suboptimal due to its low fertility rate, which negatively impacts the productivity of crops cultivated by farmers in the region [2]–[5]. Consequently, there is an imperative for technological and innovative solutions that leverage local resources to enhance agricultural and plantation productivity in Papua, ensuring high economic efficiency. A promising approach involves the utilization of livestock waste as a fertilizer source. The chemical composition of the fertilizer derived from waste is as follows: Nitrogen (N) 0.33%, Phosphorus (P) 0.11%, and Potassium (K) 0.13% [6]. One proposed solution involves the utilization of livestock waste, which is deficient in nutrients, in conjunction with natural phosphate from Maybrat Regency. The incorporation of this natural phosphate has been demonstrated to enhance nutrient content and soil pH [7]. Phosphate soil, a natural form of phosphate derived from geochemical processes, contains between 18-25% P2O5 [8]. The fertilization process involving soil phosphate deposits offers a viable solution to address the phosphate requirements of plants in a manner that is environmentally sustainable [9], [10]. In contrast to chemical phosphate fertilizers, phosphate rock does not leave behind any residue after application [11], [12].

According to Sorong Regency BPS Data, the beef cattle population is projected to reach 24,451 by 2023, with a primary focus on meat production as a source of animal protein. In addition to meat, cattle farms also generate waste feces and urine. The average fecal output of bovines is estimated to be 10-20 kilograms per day [13]. Furthermore, the liquid waste produced by one adult cow is approximately 8 to 12 liters per day [14]. The total waste production of the entire livestock population is estimated to be 244,510 kilograms per day. The utilization of these waste materials offers significant potential for conversion into valuable byproducts. Specifically, the feces and urine can be processed to generate solid and liquid organic fertilizers, thereby enhancing agricultural productivity [15], [16]. Additionally, these waste materials can be transformed into biogas, a renewable energy source that can contribute to the development of sustainable energy infrastructure [17]. The treatment of livestock waste has been shown to enhance the availability and content of nutrients, thereby increasing the agricultural value of such waste when utilized as fertilizer [18]. This approach aligns with the principles of a circular economy, emphasizing the reuse and recycling of resources [19]–[21]. The strategic application of appropriate technologies and innovative approaches holds the potential to transform livestock waste into a valuable product, rivaling the economic worth of the primary livestock product. Klasuluk village in Sorong regency is predominantly populated by individuals engaged in agricultural and livestock-related activities, with a total of 605 households in the year 2024.

The Tunas Siaga Livestock Farming Group, the primary partner, is confronted with challenges related to production and marketing. The farm's potential to produce organic fertilizers stands at 164 tons per year; however, its current output stands at 20 tons, representing a mere 11.98% of the potential yield. This suboptimal performance can be attributed to constraints in human resources and infrastructure. A mere 8 out of 20 members possess the necessary skills in waste treatment, resulting in a mere 35% of waste being processed into compost. To address these challenges, a series of solutions have been proposed, including training programs focused on waste treatment into solid and liquid fertilizers and biogas. The training programs will be complemented by the incorporation of Krandalite Phosphate Deposited Soil (KPDS), a measure aimed at enhancing the quality of the resulting fertilizers. The involvement of productive youth is also crucial to meet fertilizer needs in Sorong regency.

Karang Taruna Tunas Bangsa in Klasuluk village has 23 members. Despite their strong motivation to contribute to productive activities, their involvement in livestock waste management remains minimal. The youth of Karang Taruna Tunas Bangsa possess considerable potential for engagement in livestock waste management; however, the primary impediment is their lack of skills and knowledge regarding waste

Vol. 9., No. 1, February 2025, pp. 19-27 ISSN 1978-0524 (print) | 2528-6374 (online)

treatment technology. A mere 25% of the members possess a rudimentary understanding of the waste treatment process. To address this gap, there is a clear need for intensive training and technological support to facilitate the initiation of businesses centered on livestock waste treatment.

Both partners encounter interrelated challenges. The Tunas Siaga livestock farmer group has not yet capitalized on the potential of livestock waste as a high-quality fertilizer, whether solid or liquid, with the incorporation of KPDS. A survey of the field revealed that a mere 20% of total livestock waste is utilized for basic composting, primarily due to farmers' limited energy and time resources, which hinders the processing of livestock waste. Conversely, Karang Taruna Tunas Bangsa lacks initiatives to advance the region and its own capacity. The proposed program is designed to address these deficiencies by leveraging the collaborative efforts of all parties to produce high-quality compost from both livestock waste and the program's own resources. The program will be structured in two stages: an extension/socialization stage and a training/practice stage. The program's implementation team anticipates a high level of community engagement, with 90% of the population expected to participate. This initiative is set to be executed in conjunction with farmers and livestock groups in Kampung Klasuluk, Sorong regency. The program's outcomes are anticipated to enhance the knowledge of program participants by 90%, and to yield the production of tekf solid and liquid compost fertilizer products.

2. Method

2.1. Time and Place of Activity

The location of Kosabangsa Year 2024 activities will be implemented in Klasuluk Village, Mariat District, Sorong Regency. Klasuluk Village is mostly inhabited by people who work as farmers and breeders. This activity is scheduled to take place from October to November 2024. The program is designed to utilize time effectively, so that each stage of implementation can run smoothly and coordinated. During the two-month period, the main focus of the program is to increase the capacity of the local community in livestock waste management through training and mentoring.

Through various training sessions, participants will gain knowledge and practical skills in the production of solid and liquid organic fertilizers with the addition of KPDS. The aim of this activity is to increase the productivity and sustainability of agricultural and livestock practices in the region. It is hoped that with this program, the community of Kelurahan Klasuluk can optimize the potential of local resources and improve overall economic welfare. A collaborative approach involving various parties will also be key to ensuring the success and sustainability of the program in the long run

2.2. Activity Objectives

The target of Kosabangsa Year 2024 activities referred to as activity partners are the Tunas Siaga Livestock Farmer Group with 20 members and the Tunas Bangsa Youth Organization with 23 youth members. The active involvement of these two groups is expected to increase productivity and innovation in processing livestock waste into products of economic value. The training and mentoring that will be provided covers various aspects, ranging from waste processing techniques into solid and liquid organic fertilizers, to the addition of organic fertilizer quality with the addition of Krandalit Phosphate Deposited Soil (KPDS) from Maybrat Regency.

2.3. Flow of Activity

Activities in the field will begin with socialization and identification of the needs of the Tunas Siaga Livestock Farmer Group and Karang Taruna Tunas Bangsa in Klasuluk Village. At this stage, the implementation team will convey information about the Kosabangsa program and cooperation opportunities to the farmer groups. The purpose of this activity is to provide a deep understanding of the program and how to utilize it. Socialization will be conducted through face-to-face meetings and distribution of information materials.

After that, the implementation team will conduct interviews and discussions with the Tunas Siaga Livestock Farmer Group to identify the needs and potentials that will be submitted in the Kosabangsa proposal. This step is very important to ensure that the proposal submitted truly reflects the real needs in the field and has the potential to provide significant benefits to the community. Kosabangsa activity flow show in Fig. 1.

ISSN 1978-0524 (print) | 2528-6374 (online) Vol. 9., No. 1, February 2025, pp. 19-27

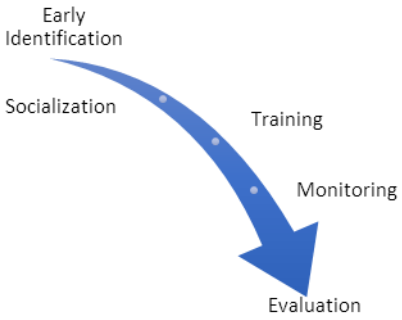

Fig. 1. Kosabangsa Activity Flow

We will also provide education to Tunas Siaga Livestock Farmer Group and Tunas Bangsa Youth Organization on the method of processing livestock waste into solid and liquid organic fertilizer with the addition of Krandalit Phosphate Deposited Soil (KPDS). Materials to be delivered include fermentation techniques, selection of additional ingredients, and effective production processes. Product packaging and marketing training will be conducted through digital and conventional marketing, with a focus on making KPDS compost in liquid and solid form.

The training will cover practical steps in assembling, operating and maintaining biogas digesters, as well as how to manage biogas residue that can be used as organic fertilizer. In addition, training on compost design and packaging as a marketing strategy will teach participants how to create attractive and functional packaging for their compost products, with a focus on branding and market appeal.

The technologies and innovations that will be introduced to the target community include the manufacture of organic fertilizers in liquid and solid form with easily obtained raw materials. The addition of KPDS in making organic fertilizer from livestock waste is expected to improve the quality of the product produced. The utilization of this fertilizer is expected to reduce farmers' dependence on chemical fertilizers, which are often difficult to obtain.

Monitoring and evaluation will be conducted regularly to assess progress and identify areas for improvement. Collaboration with government, educational institutions, and the banking sector will strengthen financial and technical support, ensuring the program remains relevant and effective. By actively involving the community and ensuring a good feedback mechanism, the program is expected to adapt to local needs and provide long-term sustainable benefits.

To ensure the sustainability of the program, the steps taken include strengthening local institutions to facilitate the sustainable application of technology, providing follow-up training, and capacity building for the community to continue to develop and improve technology, as well as assisting the community in accessing markets to sell agricultural products and derivative products such as organic fertilizer. Monitoring will be carried out using an assessment rubric tailored to the conditions of the Tunas Siaga Livestock Farmer Group and Tunas Bangsa Youth Organization partners. In this case, students will be directly involved in the field to provide assistance and carry out monitoring tasks.

2.4. Evaluation Of Activities

Evaluation of this activity will be carried out through pretests and posttests given to participants before and after the training. The purpose of this evaluation is to measure the improvement of participants' knowledge and skills in processing livestock waste into high economic value products. In addition, the evaluation will also include direct observation of the application of the techniques that have been taught during the training.

The pretest and posttest questions consisted of 25 questionnaire items with a Likert scale containing five answer options. The scale was designed to measure participants' level of understanding and skills before and after the training. Participants are asked to rate statements related to knowledge and skills in livestock waste management, with answer options ranging from "strongly disagree" to "strongly agree". Once the data is collected, a statistical analysis will be conducted using a partial T-test through SPSS version 27 software. The results of this partial T-test will provide an overview of the significance of the differences in participants' knowledge and skills before and after the training. By utilizing SPSS version

Vol. 9., No. 1, February 2025, pp. 19-27 ISSN 1978-0524 (print) | 2528-6374 (online)

27, this analysis is expected to provide empirical evidence of the effectiveness of the training program that has been implemented.

If the results of the analysis show a significant difference, it can be concluded that the training was successful in improving participants' capacity in livestock waste management. Conversely, if there is no significant difference, further evaluation will be required to identify factors that hindered the improvement and make necessary adjustments to future training programs.

3. Results and Discussion

3.1. Livestock Waste Processing

A series of educational programs on livestock waste management has been conducted for designated beneficiaries by Dr. Mohamad Jen Wajo, M.P. The training session focused on enhancing the participants' proficiency in waste management techniques, with a particular emphasis on the production of high-quality organic fertilizer. The materials presented included the use of biodigester technology for biogas production as well as the management of biogas residue into organic fertilizer. The processing of livestock waste by controlled anaerobic fermentation was also discussed [22]. The biogas process's byproducts can be further processed to create fertilizers that are beneficial to plant life [23]. The training method employed an interactive and participatory approach, allowing participants to engage directly with the techniques and apply them to their daily activities. Socialization show in Fig. 2.

Fig. 2. Socialization of Livestock Waste Processing

Furthermore, the presenters emphasized the importance of collaboration between farmer groups and youth communities in developing waste management-based businesses. Participants were encouraged to share their knowledge and experience and establish partnerships with other parties that can support their business in the future. Through this training, it is hoped that participants can become more independent and innovative in processing livestock waste, so as to provide added value to the local economy and improve the welfare of the community in Klasuluk Village.

3.2. Utilization of KPDS in Organic Fertilizer

Socialization and training in the utilization of Krandalite Phosphate Deposited Soil (KPDS) was presented by Dr. Ir. Ishak Musaad, M.P. as a patent holder in the utilization of KPDS to increase the quality of organic fertilizer as show in Fig. 3. He is one of the experts in organic fertilizer processing technology. In this session, Dr. Ishak Musaad explained the benefits and techniques of using KPDS to improve the quality of organic fertilizers in both solid and liquid forms. Participants were given an in-depth understanding of how KPDS works in improving soil structure and nutrient content, as well as how to integrate it into the livestock waste treatment process.

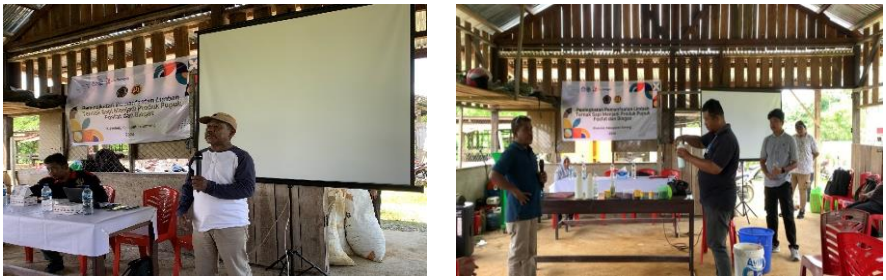

Fig. 3. Training on making solid and liquid organic fertilizers with the addition of KPDS

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The training was conducted with a practical approach, where participants were invited to try directly mixing KPDS with other organic materials. Dr. Ishak also led a discussion on challenges that may be faced in implementing this technology in the field, such as difficulties in obtaining raw materials or other technical constraints. Participants were encouraged to share their experiences and discuss solutions that could be implemented according to their local conditions.

Training in the production of organic fertilizers with the incorporation of natural phosphate has been demonstrated to enhance crop yield while reducing the reliance on chemical fertilizers, which can potentially compromise soil quality [24]. This training also provides assistance in the production of liquid fertilizers, which utilize liquid waste from livestock. The development of these liquid fertilizers not only facilitates the application process but also enhances the economic viability of agricultural activities, thereby contributing to the overall income enhancement of farmers [25].

Through this training, participants are expected to apply this new knowledge to improve agricultural and livestock productivity in their areas. Thus, the use of KPDS not only contributes to increased agricultural production, but also opens up new economic opportunities for local communities, particularly to improve product quality in the area of livestock waste utilization.

3.3. Marketing of Livestock Waste Processing Products

The socialization and training of marketing livestock waste products in partners was presented by Dr. Ir. Umi Yuniarti, M.P. With an approach that focuses on developing marketing strategies, Dr. Umi Yuniarti provides in-depth insights into digital and conventional marketing techniques that can be applied by partners as show in Fig. 4. The material presented included how to build brand awareness, use social media for promotion, and effective sales strategies. Participants were invited to understand the importance of attractive and functional packaging, and how to create added value through product storytelling.

Fig. 4. Marketing Training for Processed Livestock Waste Products

The training program placed particular emphasis on the significance of establishing connections with local and regional markets as a strategy to augment sales. Dr. Umi Yuniarti further encouraged participants to innovate in the creation of products derived from livestock waste that can meet market needs. Participants were also given case simulations on how to overcome challenges in product marketing, such as price competition and dynamic consumer preferences. A sales strategy for organic fertilizer products that improves quality and utilizes online media for marketing purposes has the potential to increase sales [26].

Through this initiative, it is hoped that partners will be able to improve their marketing skills so that livestock waste processing products can be more widely recognized and make a real contribution to improving the local economy. The competencies acquired through this training are anticipated to serve as a foundation for partners to develop their enterprises independently and sustainably

3.4. Evaluation of Activities

Evaluations are conducted to ensure that program objectives are achieved and have a positive impact on partners and communities. Evaluations are conducted through a variety of methods, including interviews, direct observation, and specially designed questionnaires to assess the improvement of participants' knowledge and skills. In addition, the evaluation also assessed the effectiveness of the training methods and support provided during the program.

The results of the evaluation showed that most of the participants experienced a significant increase in their knowledge and skills in livestock waste management by 64.4%. This was reflected in the pretest

Vol. 9., No. 1, February 2025, pp. 19-27 ISSN 1978-0524 (print) | 2528-6374 (online)

and posttest results which showed an increase in participants' average scores. Many participants reported that they felt more confident in applying the new techniques learned during the training. Service activities in Klasuluk Village as show in Fig. 5.

Fig. 5. Service Activities in Klasuluk Village

However, the evaluation also identified some constraints that need to be addressed in future program implementation. As a follow-up, the implementation team plans to provide ongoing support and advanced training for the participants. This includes assisting partners in accessing the necessary raw materials and technology, as well as supporting them in developing a wider marketing network. With these measures, it is expected that the program will not only provide short-term benefits but also contribute to the long-term economic and environmental sustainability of the community in Klasuluk Village.

4. Conclusion

The innovation with the addition of KPDS to solid and liquid organic fertilizers was well received by the target partners. The evaluation results showed that most participants experienced a significant increase in their knowledge and skills in livestock waste management by 64.4%. This was reflected in the pretest and posttest results which showed an increase in the average score of the participants. The paired T-test results showed a significant difference ($P<0.05$) between the pretest and posttest given to the partners.

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Declarations

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