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Diversification of Maggot Derivative Products in the Kompas Lestari Program in Makartitama Village, Paninjauan Regency, South Sumatra

Richa Amalia[1], Erwin Hendra Putra[2*], Suharyadi[3*]*

[1]CDO Pertamina Ogan Komering Field

[2]Officer ComRel & CID Zona 4

[3]Enviromental Officer PHE Ogan Komering

E-mail: [1)] richaamalia22@gmail.com

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*Coresponding author:
Richa Amalia
richaamalia22@gmail.com

ABSTRACT

The success of the Waste Bank in reducing organic and inorganic waste in Makartitama Village, OKU, has inspired PT Pertamina Hulu Energi Ogan Komering to develop the Sustainable Waste Management Group Sinergi PHE Ogan Komering (KOMPAS LESTARI). The primary focus of this program is to utilize organic waste for cultivating Black Soldier Fly (BSF) maggots, which are then used in the production of pellets or alternative fish feed for freshwater aquaculture and liquid organic fertilizer for organic vegetable cultivation. In 2023, the BSF-based products, initially used by the beneficiary groups of Kompas Lestari, are being developed for commercialization. In its third year, Kompas Lestari is embarking on a business incubation phase for processed maggot products. This phase includes training in product diversification, marketing strategies, and registration for Home Industry Food (P-IRT).

Keywords: Waste Bank, Kompas Lestari, BSF Maggots, Business Incubation, Product Diversification

1. Introduction

Waste management remains a significant challenge for the Indonesian government. Population growth, increased consumption, and economic activities directly impact the rise in waste production. With Indonesia's population reaching 275.5 million in 2022, it is virtually impossible to reduce overall waste generation. However, reducing waste accumulation through effective and integrated management practices is feasible.

According to Chaerul et al. (2007), issues in waste management in Indonesia include insufficient legal frameworks, inadequate waste disposal infrastructure, limited composting efforts, and ineffective management of final disposal sites. Addressing these limitations could mitigate environmental pollution from waste and potentially open new economic opportunities for local communities.

Data from the site sipsn.menlhk.go.id/sipsn indicates that Indonesia's waste production is 17,934,071.68 tons annually. Specifically, in the Peninjauan District, South Sumatra Province, waste accumulation totals 12.97 tons, with 7.78 tons of organic and 5.19 tons of non-organic waste. This district, located in Ogan Komering Ulu Regency, falls within the operational area of PT Pertamina Hulu Energi Ogan Komering (PHE Ogan Komering). In this district, particularly in Makartitama Village, a significant amount of waste from community activities must be better managed. If left unaddressed, this waste can accumulate and lead to more severe problems, such as the development of slum areas, health issues, and environmental damage.

Makartitama Village is densely populated, with 180 out of 556 families (approximately 32.37%) classified as pre-prosperous. Most residents work in palm oil and rubber plantations, with fluctuating incomes due to weather and commodity prices. This economic instability affects various aspects of life, including health and education. Despite this, Makartitama Village has significant human resource potential, with 44.23% of its population being of productive age, totaling 1,935 individuals.

The residents of Makartitama Village need a cohesive understanding and system for waste management. Most waste is either burned, discarded behind homes, or dumped into waterways, leading to environmental pollution, such as the proliferation of disease-carrying animals (flies and maggots), contamination of groundwater, and pollution of food sources. In 2018, PHE Ogan Komering collaborated with the Village-Owned Enterprise (BUMDes) Makartitama to develop community capabilities through waste management. Waste management involves converting household waste into economically valuable items, providing income opportunities for residents while indirectly improving the environment. This initiative is named the Waste Bank of the Sustainable Waste Management Group Sinergi PHE Ogan Komering (KOMPAS LESTARI).

The Kompas Lestari Waste Bank collects household waste from the community, including both organic and non-organic waste. Initially, the program focused on managing and recycling non-organic waste, which proved successful by generating an average monthly revenue of IDR 1,664,000 from approximately 832 kg of waste collected monthly.

Subsequently, under the initiative of PHE Ogan Komering, the program expanded its activities starting in 2021. The development of Kompas Lestari was based on social mapping documents from 2022. All Kompas Lestari activities are centered around managing organic waste for cultivating Black Soldier Fly (BSF) maggots produced at the Maggot Cultivation Study Center in Makartitama Village. Kompas Lestari focused on forming support groups and building facilities in the first year. In the second year, training sessions were conducted to enhance the capabilities of each group. By the third year, Kompas Lestari concentrated on product diversification and marketing, enabling the products to be utilized by a broader audience beyond the groups.

2. Literature Review

Maggots, or Black Soldier Fly (BSF) larvae, scientifically known as Hermetia illucens, originate from eggs and undergo metamorphosis into adult flies. The BSF is a large, black fly with white legs. Maggots are highly effective in decomposing organic waste, including manure, as they are detritivores, organisms that feed on decaying plant and animal matter. Consequently, maggots are adequate for composting organic waste, particularly in densely populated countries like Indonesia. According to a report from the official site sipsn.menlhk.go.id, in 2022, 30.6% of Indonesia's total waste is food waste.

Feeding biological waste to BSF also helps prevent the spread of pathogens such as Salmonella spp., thereby reducing the risk of disease transmission between animals and humans when this technology is used in livestock farming or animal waste processing (e.g., poultry manure or slaughterhouse waste) (Suryaneta et al., 2022).

Maggots can decompose organic waste without emitting unpleasant odors, making them suitable for production in residential or domestic settings. According to the official Instagram account of the West Java Environmental Agency @dlh_jabar, 1 kg of BSF maggots can decompose 2-5 kg of food waste per day. Furthermore, maggots are hygienic and do not carry disease sources harmful to livestock or humans.

The life cycle of BSF, from egg to larva, depends on environmental factors such as temperature, sunlight, the presence of BSF in the breeding area, the quality of the breeding flies, and food conditions. Once hatched, the larvae enter a feeding stage, during which their mouth structure changes to a hook-like form, and their color changes to brown. This mouth structure helps them move from the food source to new, dry, enclosed, and protected environments (Dortmans et al., 2017).

Maggots are highly nutritious animal feed, containing essential nutrients for the growth and development of animals, particularly poultry and freshwater fish. These nutrients include protein, fat, essential amino acids, and minerals. Maggots can be processed into maggot meals and used as raw materials

to produce mixed feed. They are an excellent substitute for meat bone meal (MBM) in animal feed, meeting all the criteria for feed ingredients.

Given their significant potential, maggot cultivation presents a highly profitable business opportunity. The short cultivation cycle, ease of process, and low costs allow the residents of Makartitama Village to enhance their well-being and contribute to environmental preservation.

3. Methodology

In preparing the Kompas Lestari program's development plan, PHE Ogan Komering evaluated the community development program of Bank Sampah. This study employed a qualitative research method to explain the social phenomena occurring in the community. According to Creswell (2014), qualitative research is an approach to understanding phenomena through interpretation and descriptive analysis.

Sampling was carried out using purposive sampling to gather as much information as possible from various sources within its context. The sources in this study are the beneficiaries. Data from these sources were enriched by additional sources recommended by the initial ones, relevant to the type of data needed, a technique known as snowball sampling. This technique starts with a few individuals or cases and then expands based on the relationships with respondents (Nurdiani, 2014). The number of sources was determined by the sufficiency of information, indicated by the repetition of information among informants.

The required data include primary and secondary data. Primary data are obtained through in-depth interviews, while secondary data are gathered from other supporting documents. These data serve as references for the company in preparing strategies for developing the Kompas Lestari program. This program targets the community of Makartitama Village, which falls into the Pre-Prosperous family category.

4. Results and Discussion

4.1. Results

4.1.1. Program Implementation

Following the evaluation, PHE Ogan Komering began developing the Kompas Lestari program in 2021 to address environmental and public health issues in Makartitama Village. This development started with the forming of several groups under the Kompas Lestari umbrella, each representing specific program objectives. The groups are:

1. Maggot Cultivation Group: Aimed at achieving sustainable management of household organic waste.
2. Fishing Tourism and Freshwater Fish Cultivation Group: Focused on creating new job opportunities for the local community.
3. Organic Vegetable Cultivation Group: Aimed at food security and producing products for direct consumption.
4. GEN SMART (Healthy and Intelligent Generation) Group: This group is focused on improving Healthy Living Behavior (PHBS) and preventing stunting.

These four groups work synergistically to address community issues. By applying sustainability principles, Kompas Lestari creates a value chain that reaches three target sectors: the general public, pregnant and breastfeeding women, and businesses. The flow of the Kompas Lestari program is as follows:

- Waste Collection: Waste is collected from households and PHE Ogan Komering and transported to the Bank Sampah in Makartitama Village.
- Organic Waste Processing: Organic waste from the Bank Sampah is used by the Maggot Cultivation Group as feed for maggots at the Maggot Cultivation Study Center. The Organic Vegetable Cultivation Group uses by-products of maggot cultivation, such as organic fertilizer from maggot BSF feed waste. Other by-products, such as high-protein maggot-based pellets (Pelgot), are used as alternative fish feed by the Fishing Tourism and Freshwater Fish Cultivation Group in the village reservoir.

- Nutritional Support: The GEN SMART Group produces organic vegetables and freshwater fish to provide nutritious food for pregnant women, breastfeeding mothers, and children and to prevent stunting.
- Recycling: Waste from vegetables, fruits, and fish cultivated by the groups is processed into maggot feed.

In 2022, PHE Ogan Komering provided training to develop the knowledge and skills of group members. The training included maggot cultivation, freshwater fish farming, tourism development, and complementary infant foods (MPASI) preparation.

In its third year, the Kompas Lestari program focused on business incubation, specifically diversifying maggot-derived products to make them suitable for use by other groups and sale to external consumers. For this purpose, PHE Ogan Komering collaborated with the Animal Husbandry Department of Sriwijaya University to provide training. The training agenda included the production of maggot pellets (Pelgot) as alternative fish feed, which can be used in the operations of freshwater fish farming groups.

The training continued with experiments on producing liquid organic fertilizer (LOF) using waste from maggot feeding (kasgot), which consists of vegetable and fruit waste decomposed by maggots over a week. The waste was separated from larvae and solid residues using a sieve. The liquid waste, consisting of a mixture of larval metabolic waste and leachate from organic waste decomposition, was placed in clear bottles, loosely sealed, and sun-dried. The LOF is ready for use when the liquid turns dark brown and has a mild odor. The solid residue can also be used as compost. The liquid compost, typically dark green to black and strong-smelling, must be diluted with water before applying to soil—1 liter of water per 50 ml of LOF. LOF can reduce the nitrogen-phosphorus-potassium (NPK) fertilizer needed by 50% for soil enrichment. From 30 liters of LOF, one can fertilize 0.5 hectares of land, thus saving on operational fertilizer costs for organic vegetable cultivation. The resulting LOF is expected to improve the efficiency of vegetable farming operations and provide sustainable benefits.

In addition to LOF production, Kompas Lestari also made roasted maggots. The roasting process involves drying harvested maggots under sunlight and then roasting them in a pan to reduce moisture content. After roasting, the maggots are cooled and packaged in clean, dry, and airtight containers to prevent contamination by microorganisms.

Kompas Lestari's third product is maggot pellets (Pelgot). The production process starts with drying the maggots to reduce moisture. The dried maggots are then ground into a fine powder, mixed with bran, fish meal, and minerals in proper proportions, and blended thoroughly. A starch mixture is added to form the pellets, and the mixture is processed using a pellet machine. The resulting pellets generally retain some moisture and must be dried before packaging.

Figure 1. Characteristics of the Creative Individual

Following development, these maggot derivatives are now poised to provide economic value. Commercializing or selling these products to generate income for the group members is essential. Therefore, PHE Ogan Komering has supported the Kompas Lestari groups in facilitating the sale of maggot products. This support includes product marketing training, assistance with sales through digital platforms (e-commerce) to reach a broader market, and Household Industrial Food (P-IRT) registration.

4.1.2. Monitoring and Evaluation

In the third year of the program's development, the business incubation activities of Kompas Lestari have achieved several milestones, including:

1. Direct Impact on Environmental Preservation in Makartitama Village

In line with the program's initial objectives, Kompas Lestari's waste management has significantly reduced waste accumulation in Makartitama Village. The presence of the Waste Bank has already played a crucial role in environmental preservation. Daily, a total of 0.12 tons of waste, consisting of 0.065 tons of organic and 0.052 tons of non-organic waste, is collected and managed. This waste management has helped Kompas Lestari reduce greenhouse gas emissions by 0.0127 tons CO2eq daily.

Furthermore, maggot cultivation, which is the core activity of the program's development, has proven effective in the biological conversion of organic waste by BSF larvae. These larvae are highly beneficial for managing organic waste from both domestic and corporate sources. BSF maggots can consume all organic materials with an average pH and without containing insecticides or pesticides. For example, to decompose 4,000 grams of organic material, only about 1 gram of larvae is needed over 14 days. Similarly, to decompose 100 kilograms of organic material within 2-3 hours, 1,000 grams of 7-day-old larvae are sufficient.

Environmental preservation is also evident in agriculture. Using maggot-derived products such as LOF has improved soil nutrients that were previously degraded due to the continuous use of conventional fertilizers. This LOF, produced from BSF maggots, is utilized not only by the organic vegetable cultivation group but also in the palm oil plantations, which dominate agriculture in Makartitama Village.

2. Sustainable Economic Leverage for the Community

In addition to its environmental benefits, Kompas Lestari has also succeeded in improving the economic situation of its members, who are from the pre-prosperous category. When the program was limited to the Waste Bank, Kompas Lestari provided an additional income for its members, averaging IDR 1,664,000 from selling products made from approximately 832 kg of non-organic waste each month. Since the introduction of BSF maggot cultivation, group members have achieved an income of IDR 1,872,000 per month or approximately 208 kg per day from selling maggots.

This year, the diversification of BSF maggot derivatives has further added economic value. One successful product is the maggot pellet, used by the Fishing and Freshwater Fish Cultivation Group. Using maggot pellets as an alternative fish feed has increased operational cost efficiency. For instance, in one fish harvest cycle requiring 150 kg of feed, maggot pellets can replace approximately 75 kg of commercial feed. To replace 40%-50% or about 75 kg of commercial feed, the community only needs to spend IDR 525,000. Thus, the operational costs previously required IDR 2,000,000 per fish harvest cycle can now be reduced by IDR 475,000.

Similarly, Kompas Lestari's use of LOF has also proven economical. Previously, organic vegetable farmers used NPK fertilizer costing IDR 1,000,000 per 50 kg (equivalent to IDR 20,000 per kg) and required 2 kg of fertilizer per 100 liters of water (equivalent to IDR 40,000 per kg). With the introduction of LOF, NPK use can be reduced by 25% by mixing 200 ml of LOF. Consequently, the cost of NPK per fertilization cycle has decreased from IDR 40,000 to IDR 30,000.

3. Enhanced Community Capabilities

After forming several support groups, Kompas Lestari members have received various trainings to accommodate their group's activities. These trainings include BSF maggot cultivation, freshwater fish cultivation, organic vegetable farming, and stunting prevention for children. Strengthening community

capacity through training is crucial, as the program's sustainability depends on the quality of human resources capable of managing and utilizing both organic and inorganic waste sustainably.

This year, PHE Ogan Komering, in collaboration with the Department of Animal Husbandry at Sriwijaya University, carried out knowledge transfer and skills enhancement, focusing on the development of BSF maggot derivatives. The training, attended by 20 Kompas Lestari members from the village's reservoir area, provided knowledge and practical skills, including operating machinery for pellet production. The community aims to eventually produce maggot pellets for alternative fish feed independently.

4. Strengthened Social Ties Among Kompas Lestari Members and the Community

The Waste Bank initiative has fostered a positive perception among Makartitama Village residents toward PHE Ogan Komering's community development programs. This positive perception stems from the tangible benefits of waste management for the environment, health, and economy. This goodwill has facilitated the company's guidance in other programs, as evidenced by the increased community involvement as group members. The community also actively participates in and supports Kompas Lestari's initiatives.

5. New Value Chain Developments

The diversification of maggot-derived products has benefited other community groups. Organic fertilizer produced from maggot waste (kasgot) is reused by women's groups in Makartitama Village to grow vegetables. Maggot pellets are used for freshwater fish farming in the village reservoir. The harvests from vegetable and fish cultivation are further utilized to assist Posyandu cadres in making complementary foods for infants and household consumption.

Posyandu cadres in Makartitama Village collaborate with the Gen-Smart group to provide education and handle stunting issues, including providing complementary foods for infants and pregnant women. Thus, the Kompas Lestari's maggot production provides economic benefits through operational efficiencies in fish feed and contributes to community health.

5. Conclusion

Kompas Lestari has had several positive impacts on the quality of life in Desa Makartitama, both environmentally and economically. The diversification of maggot-derived products this year has successfully enhanced the economic value of maggot cultivation. Organic Liquid Fertilizers (LOF) and maggot pellets, which have demonstrated superior nutritional content to conventional fertilizers and pellets, have proven effective in enhancing and maintaining the quality of organic crop and freshwater fish production. These derivative products efficiently reduce cultivation operational costs, increasing the income of organic farmers and fish breeders. In addition to internal use within the Kompas Lestari groups, these diversified products have begun to be marketed online. Using the online market indicates that maggot-derived products are now accessible to consumers beyond Desa Makartitama. However, the current sales figures are still modest, suggesting that continued support from PHE Ogan Komering is necessary to expand the market for maggot-based products in the future.

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