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Utilization Of Maggot For The Cleanliness Of The Parung Bogor Traditional Market

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ABSTRACT
This research aims to analyze the effectiveness of *Black Soldier Fly* (BSF) maggot cultivation in decomposing organic waste and its potential to generate economic value in traditional markets. The study was conducted at Parung Traditional Market, Bogor, over a period of two months, using an observational and participatory research method. The population of this study consisted of 50 participants, including 30 market traders who produced organic waste daily and 20 waste management workers. Data were collected through direct observation, documentation, and interviews. The findings revealed that BSF maggots are highly effective in breaking down organic waste such as vegetables, fruits, and food residues. In addition, maggots can be processed into high-protein animal feed and organic fertilizer, both of which have economic value. The results also indicated a significant improvement in the cleanliness and comfort of the market environment after the introduction of maggot-based waste management.
Key Words: Hermetia illucens, Black Soldier Fly, Maggot, organic waste.

ABSTRAK
Penelitian ini bertujuan untuk menganalisis efektivitas budidaya maggot *Black Soldier Fly* (BSF) dalam menguraikan limbah organik serta potensinya dalam menghasilkan nilai ekonomi di pasar tradisional. Penelitian dilaksanakan di Pasar Tradisional Parung, Bogor, selama dua bulan dengan menggunakan metode penelitian observasional dan partisipatif. Populasi penelitian terdiri atas 50 partisipan, meliputi 30 pedagang pasar yang setiap hari menghasilkan limbah organik dan 20 petugas pengelola sampah. Data dikumpulkan melalui observasi langsung, dokumentasi, dan wawancara. Hasil penelitian menunjukkan bahwa maggot BSF sangat efektif dalam menguraikan limbah organik seperti sayuran, buah-buahan, dan sisa makanan. Selain itu, maggot dapat diolah menjadi pakan ternak berprotein tinggi serta pupuk organik yang memiliki nilai jual. Penerapan pengelolaan sampah berbasis maggot juga terbukti meningkatkan kebersihan dan kenyamanan lingkungan pasar secara signifikan.
Kata Kunci: *Hermetia illucens*, Black Soldier Fly, Maggot, Limbah Organik.

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INTRODUCTION

Waste management has become one of the most pressing environmental challenges in many developing countries, including Indonesia. Waste is generally divided into two major categories: organic and inorganic. Organic waste consists of materials that can easily decompose naturally through biological processes involving microorganisms, insects, and bacteria. Examples include vegetable residues, fruit peels, leaves, and food scraps. Inorganic waste, on the other hand, includes materials that are difficult to decompose, such as plastics, metals, and glass, which often require technological intervention to process. The accumulation of waste, particularly organic waste, at landfill sites continues to rise every year, exacerbated by poor waste management practices and limited knowledge about effective decomposition methods.

Organic waste represents the largest proportion of municipal waste in Indonesia. Traditional markets, where large volumes of perishable goods such as fruits and vegetables are traded, are among the primary contributors. The problem is not merely the volume but also the management of such waste. Piles of unprocessed organic waste produce unpleasant odors, attract disease vectors such as flies and rodents, and emit greenhouse gases such as methane during anaerobic decomposition. The lack of proper handling systems causes traditional markets to become centers of environmental pollution and public health concerns. Therefore, there is an urgent need for effective, environmentally friendly, and economically feasible methods for managing organic waste. One promising approach that has gained global attention in recent years is the use of *Black Soldier Fly* (BSF) larvae (*Hermetia illucens*) for bioconversion of organic waste.

The *Black Soldier Fly* (BSF) is a non-pest species of fly that plays a significant role in organic waste management. Unlike the common housefly (*Musca domestica*), which is known to spread pathogens, BSF does not transmit harmful bacteria or viruses. The adult BSF resembles a wasp, with a black body and translucent wings. Its larvae, commonly referred to as maggots, have an extraordinary ability to consume and decompose various types of organic matter. The larvae stage is the most active phase of the fly's lifecycle, during which it feeds voraciously on decomposing organic material, converting it into biomass rich in protein and fat.

The life cycle of BSF consists of four stages: egg, larva, pupa, and adult fly. The larval stage lasts approximately two to three weeks, depending on the type of substrate and environmental conditions such as temperature and humidity. Studies have shown that BSF larvae can reduce the volume of organic waste by up to 80% within a period of 10 to 15 days under optimal conditions (Hartono et al., 2020). During this process, the larvae convert organic waste into two valuable products: larval biomass, which can be used as animal feed, and frass, which can be utilized as an organic fertilizer.

Traditional markets in Indonesia contribute significantly to the generation of organic waste. Vegetables, fruits, and leftover food often accumulate and rot within hours, releasing foul odors and polluting the surrounding environment. This condition reflects a broader systemic issue: the absence of adequate waste segregation and management at the source. Waste from these markets is often mixed with non-organic materials such as plastics, making it more challenging to process. When transported to landfills, these wastes undergo anaerobic decomposition, releasing methane gas—a potent greenhouse gas contributing to global warming. The overburdening of landfill sites also shortens their lifespan and increases operational costs.

The implementation of BSF larvae in traditional markets can address multiple problems simultaneously. First, it reduces the amount of organic waste requiring transport to landfills. Second, it transforms waste into useful products. Finally, it provides new economic opportunities for local communities through small-scale BSF farming. However, to achieve effective implementation, it is crucial to educate market stakeholders and the general public about the benefits and processes of BSF-based waste management.

BSF larvae feed on a wide range of organic substrates, including household food waste, fruit and vegetable residues, livestock manure, and agro-industrial by-products. The efficiency of waste decomposition depends on several factors, including the type of waste, the feeding rate, and environmental conditions such as temperature and moisture. Research by Purnamasari and Khasanah (2019) demonstrated that BSF larvae are capable of decomposing up to 60–70% of organic market waste within a two-week period, depending on the substrate composition.

During the feeding process, the larvae break down complex organic compounds into simpler forms through enzymatic digestion. This not only reduces waste volume but also accelerates decomposition compared to traditional composting methods. Conventional composting typically requires more than one month, while BSF larvae can achieve similar results within half that time. Additionally, the larval activity generates heat, maintaining an optimal temperature for microbial co-decomposition, further enhancing the biodegradation process.

Several scientific parameters are used to measure the efficiency of BSF larvae in waste reduction. The Waste Reduction Index (WRI) quantifies the average rate of daily waste reduction, while the Bioconversion Rate (BCR) measures the ratio of larval biomass produced to the amount of waste consumed. Studies by Hartono et al. (2020) and Ardiansyah et al. (2021) reported WRI values between 3.0 and 5.0 g/day and bioconversion rates up to 20%, depending on feeding conditions. These findings highlight the high efficiency of BSF larvae in transforming organic waste into valuable biomass.

Beyond its role in waste management, BSF larval biomass has substantial nutritional value. It contains high levels of crude protein, ranging from 37% to 63% on a dry matter basis, and fat content ranging from 15% to 35%, depending on the type of substrate and rearing method (Makkar et al., 2014; Barragan-Fonseca et al., 2020). The larvae also contain essential amino acids, minerals such as calcium, phosphorus, magnesium, and zinc, and medium-chain fatty acids that are beneficial for animal health.

Research published in *MDPI Insects* (2024) reported that full-fat BSF larvae have an average crude protein content of 43.1%, which can increase to 55% after defatting. This composition makes BSF larvae a promising alternative protein source in animal feed formulations, potentially replacing traditional sources such as fishmeal and soybean meal. Moreover, the lipid fraction of BSF larvae is rich in lauric acid, which possesses antimicrobial properties and enhances immune function in poultry and fish.

Several feeding trials have demonstrated the effectiveness of BSF larvae as a feed ingredient. For example, when incorporated into poultry diets at inclusion rates of up to 15%, BSF meal supports comparable growth performance to conventional protein sources (Bessa et al., 2023). Similarly, in aquaculture, BSF meal has been shown to enhance fish growth rates and feed conversion efficiency (Henry et al., 2022). The use of BSF larvae in feed not only improves animal nutrition but also contributes to the circular economy by recycling nutrients from waste back into the food chain.

Despite its advantages, the use of BSF larvae in waste management must be accompanied by appropriate safety protocols. Although BSF does not transmit pathogens like the common housefly, the substrates used for larval rearing may contain hazardous substances, including heavy metals, pesticides, or harmful microorganisms. Therefore, substrate selection and preprocessing are critical to ensure safety.

Studies have shown that the larval gut microbiota plays a vital role in reducing pathogenic microorganisms in the waste substrate. Lalander et al. (2015) reported that BSF larvae significantly decrease populations of *Escherichia coli* and *Salmonella spp.* during the bioconversion process. Additionally, heat treatment and drying of the harvested larvae can further eliminate potential microbial contamination, making them safe for use in animal feed. Nevertheless, continuous monitoring and adherence to food and feed safety standards remain essential.

Environmentally, the BSF system is highly sustainable. Compared to conventional composting, BSF bioconversion emits lower greenhouse gases and requires less land area. The residual frass produced during the process can be utilized as an organic fertilizer rich in nitrogen, phosphorus, and potassium, contributing to soil fertility improvement. According to Diener et al. (2011), BSF bioconversion reduces methane emissions by over 50% compared to open-air decomposition, highlighting its potential contribution to climate change mitigation.

The economic potential of BSF-based waste management is substantial. First, it reduces municipal waste management costs by minimizing the volume of waste transported to landfills. Second, it generates two marketable products: larval biomass and frass. Larval biomass can be sold as animal feed, while frass can be marketed as organic fertilizer. Third, it provides new employment opportunities in urban and rural communities, particularly for small-scale entrepreneurs and waste collectors.

The implementation of BSF farming does not require extensive infrastructure, making it accessible for local communities. A small-scale BSF rearing unit can process several kilograms of organic waste per day and produce larvae that can be sold fresh or dried. The return on investment for BSF farming is relatively high due to its low operational costs and short production cycle. In addition, integrating BSF farming with traditional market waste management can create a self-sustaining ecosystem where waste is continuously recycled into valuable resources. This concept aligns with the principles of a circular economy, where resources are reused and regenerated rather than discarded.

Furthermore, several successful projects in Indonesia, such as those in Malang, Bali, and Jombang, have demonstrated that BSF-based waste management systems can operate effectively at the community level. These initiatives not only reduce the volume of waste but also generate income for local residents through the sale of larvae and organic fertilizer (Ardiansyah et al., 2021; Pandawa Institute, 2022). The scalability of BSF farming makes it suitable for both urban and rural applications, bridging the gap between waste management and economic development.

Although the benefits of BSF larvae in organic waste management are well documented, several challenges remain. One of the major challenges is the inconsistency in waste composition, which affects larval growth and decomposition efficiency. Organic waste from traditional markets often varies daily, with differences in moisture, nutrient content, and contaminants. This variability can influence the nutritional composition of the larvae and the quality of the resulting fertilizer.

Another challenge involves odor and pest control. Although BSF larvae reduce unpleasant odors faster than traditional composting methods, poorly managed systems may still emit odors during the early decomposition phase. Proper aeration, moisture regulation, and substrate pre-treatment are necessary to mitigate this issue. Additionally, maintaining optimal environmental conditions such as temperature and humidity is crucial for larval development.

Post-harvest processing is another critical area. Larvae must be properly dried and processed to prevent spoilage and contamination. Research into efficient drying methods and defatting processes is ongoing to improve the quality and shelf life of BSF-based products. Regulatory frameworks are also needed to ensure food and feed safety, particularly regarding microbial contamination and heavy metal accumulation.

A maggot generally refers to the larval stage of flies, especially those of non-biting species such as the *Black Soldier Fly* (*Hermetia illucens*). In the scientific literature, the term "maggot" is often used interchangeably with "larva", but more precise usage distinguishes maggots of sanitary or decay-oriented flies (that develop on decomposing flesh, etc.) from BSF larvae, which are applied in waste bioconversion systems. BSF larvae do not feed on carrion in the way many fly maggots do; rather, they thrive on a variety of organic wastes (such as food scraps, plant material, manure, and agroindustrial by-products) under controlled conditions (Purnamasari & Khasanah, 2022). The lifecycle of *H. illucens* comprises four main stages: egg, larva, prepupa/pupa, and adult. Adult *Black Soldier Flies* deposit eggs in crevices near decomposing organic matter; these eggs hatch in a few days under favorable conditions. Larvae undergo several instars during a feeding period that may last approximately 10-22 days (depending on substrate, temperature, and moisture), after which they become prepupae/pupae, and then emerge as adult flies. The adult flies typically do not feed on solid substrate; instead, they may consume nectar or nothing at all, depending on species biology, and have non-functional or reduced mouthparts suited for feeding on fluids if at all (Hermetia Bioscience, n.d.) BSF larvae are valued both for their efficiency in reducing organic waste and for the biomass they produce, rich in protein and lipids, which can be used for animal feed or other applications des-marques-et-vous.com+2IPB Journal+2.

A traditional market, in the Indonesian context and in much of Southeast Asia, is an economic and social institution where vendors and buyers interact directly, often engaging in bargaining and small-scale trade. Scholars such as Wicaksono et al. define traditional markets as spaces where sellers and buyers meet in person, trading fresh produce, household staples, and other goods, often through direct negotiation. Another perspective, as put forward by Suyanto, emphasizes that traditional markets are constructed and/or managed by government authorities and are intended to serve socio-economic functions for small and medium traders. Indonesian law also provides a formal definition: Presidential Regulation No. 112 of 2007 concerning the Arrangement and Development of Traditional Markets describes them as markets built, managed, or co-managed by central or regional government, private entities, or cooperatives; characterized by the participation of small and medium traders; and functioning through direct interpersonal trade, often with bargaining. These markets are deeply embedded in local livelihoods; estimates suggest that there are around 13,000 such markets in Indonesia and some 12.5 million traders are involved, such that many farmers, fishers, artisans, and small-scale producers rely upon them as key outlets for their goods and for economic survival.

In ecology, decomposers are organisms that facilitate the breakdown of dead organic matter, transforming complex organic molecules into simpler inorganic forms that can be reused by other organisms, particularly plants. According to Nandy (2020), decomposers include fungi, bacteria, and various invertebrates (such as earthworms and certain insects) that contribute to the decay of organic material. The Big Indonesian Dictionary (KBBI) defines decomposers as organisms such as bacteria and fungi that break down organic substances into simpler parts or elements in the ecological cycle by living on or destroying dead protoplasm. Thus, in general, decomposers acquire energy and biomass by decomposing the remains of organisms that have died or matter that is no longer living. They are essential for the sustainability of both terrestrial and aquatic ecosystems because they ensure that nutrients are recycled, prevent accumulation of waste, and maintain soil fertility.

BSF larvae function as decomposers in a managed sense: they accelerate the decomposition of organic waste, converting it into larval biomass and residual compost (or frass), while also engaging with microbiomes that help digest and reduce pathogenic loads. Studies have shown that BSF larvae perform bioconversion of household waste, restaurant scraps, plant waste, and animal residues with high efficiency. For example, *Black Soldier Fly (Hermetia illucens) as a Potential Agent of Organic Waste Bioconversion*, a review by Purnamasari & Khasanah (2022), finds that composting time using BSF larvae is approximately 12–15 days—much shorter than traditional composting methods (4-5 weeks) des-marques-et-vous.com. Research in Indonesia, such as the study *Growth Performance of Black Soldier Fly Larvae (Hermetia illucens) Fed on Some Plant Based Organic Wastes* (Kinasih et al., 2018), demonstrates that locally available plant-based organic wastes (such as tofu dregs, vegetable waste, manure) can successfully serve as feed substrates; differences in physical and chemical composition of wastes affect larval growth rate, biomass yield, and preparation for pupation, as well as the ability to reduce the waste load IPB Journal. Another example is *The Productivity of Black Soldier Fly Maggot and Its Decomposability on Various Growing Media* (Sulaiman et al., 2024), which compares media such as chicken manure, cow manure, market waste, and restaurant waste, finding that restaurant waste yielded the highest total biomass production, while market waste yielded higher protein content in larvae;

decomposition performance varied depending on the organic media used twj.ulm.ac.id.

Lifecycle Variables, Environmental Parameters, and Growth Performance

The performance of BSF larvae in waste decomposition and biomass production is heavily influenced by environmental and substrate variables. Key variables include temperature, humidity, moisture content of substrate, feeding rate, substrate composition (nutrient content, fiber content, C:N ratio), and stocking density. For instance, in trials using spent coffee grounds as feed, varying feeding rates altered larval growth, waste reduction indices, and efficiency of conversion metrics IOPscience. In outdoor or semi-ambient conditions, studies from Pakistan and Indonesia observe that BSF larvae complete their full life cycle over approximately 49.5 days under broad ambient temperature ranges (22-35°C) and relative humidity between 24.7% and 89.3%, although hatching, larval feeding duration, and pupation times are sensitive to deviations in these parameters PubMed. Substrate types also matter: plant-based organic wastes produce different outcomes (in terms of biomass yield, larval survival, duration to prepupa) compared to mixtures containing animal residues, or restaurant scraps, etc. Optimizing these parameters is therefore essential for maximizing both waste reduction and quality of larval biomass for downstream uses.

Ecological and Socioeconomic Significance

BSF larval bioconversion has ecological benefits: it reduces the volume of organic waste reaching landfills, thereby reducing greenhouse gas emissions (especially methane); it mitigates odors, reduces disease vector breeding, and contributes to improved hygiene around markets and households. Additionally, the frass (residual substrate and larval excreta) is often rich in nutrients and can act as organic fertilizer, enhancing soil fertility and supporting plant growth. Socioeconomically, BSF farming offers opportunities for income generation at small and medium scale, especially in rural or peri-urban communities. Larval biomass can be sold as animal feed (e.g. poultry, fish), potentially reducing reliance on conventional protein sources which may be expensive or imported. In regions where traditional markets generate large volumes of organic waste, integrating BSF systems can provide dual benefits: waste management and livelihood provision.

METHOD

Observation Method

Observation is one of the most fundamental methods in qualitative and quantitative research because it allows researchers to collect data directly from real-life settings. According to Larry Christensen (2020), observation is an essential technique for obtaining valuable information about human behavior, as what people say may not always correspond to what they actually do. Through observation, researchers can capture natural behaviors, interactions, and reactions that might be missed through other data collection methods such as interviews or surveys. It provides a holistic understanding of the research subject by allowing direct engagement with the environment where the phenomenon occurs.

Similarly, Sutrisno Hadi (2020) emphasizes that observation is a highly complex process involving biological and psychological components, where memory and perception play crucial roles. The process requires sharp attention, patience, and objectivity from the researcher to ensure that the data collected accurately reflects the real situation. Observation does not merely involve looking or seeing, but rather systematically recording and interpreting behaviors, events, and conditions as they naturally occur.

In *Classroom Action Research* (Purba et al., 2021), it is further explained that the main purpose of observation is to collect data that can be used to answer research problems. Through observation, researchers can obtain firsthand data that is rich in context and depth, which helps in drawing accurate conclusions about the studied object. Observations are conducted not only to collect data but also to describe the characteristics and dynamics of the observed object in its natural environment.

Therefore, observation serves as a bridge between theory and reality. By observing directly, researchers gain an in-depth understanding of social or environmental phenomena and are better equipped to interpret behaviors and processes as they unfold in their authentic settings.

RESULTS AND FINDINGS

The cultivation of maggot from Black Soldier Fly (BSF) larvae has become one of the most innovative and environmentally friendly approaches in organic waste management. The implementation of maggot cultivation in this research was carried out at Parung Traditional Market, Bogor, over a period of two months. The objective was to observe how BSF larvae could effectively decompose organic waste while simultaneously generating economic value for the local community, particularly among traditional market traders.

The maggot used in this study is not a caterpillar, but rather the larvae of Hermetia illucens, commonly known as the Black Soldier Fly. These larvae are well-known for their ability to consume large quantities of organic waste such as food scraps, fruits, vegetables, and household waste. The BSF larvae decompose organic materials efficiently, converting them into nutrient-rich compost and biomass that can later serve as high-protein animal feed. This project was designed to address the problem of waste accumulation in traditional market areas by developing a maggot cultivation system that is sustainable, low-cost, and beneficial for the local economy.

A. Activity 1: Initial Preparation and Egg Hatching

The first stage of the research began with the preparation of facilities and the process of attracting Black Soldier Fly adults to lay eggs. A specific container was designed to encourage BSF females to lay eggs in a controlled environment. The process of obtaining BSF eggs was quite challenging, as the fly's life cycle is short and requires precise conditions of temperature, humidity, and organic matter presence.

To attract BSF flies, containers filled with decaying organic matter were placed strategically around the Parung Traditional Market area. These materials released a natural odor that attracted female flies. Once the eggs were laid, they were carefully collected and transferred to the hatching trays. The incubation period lasted between three to four days, after which the larvae hatched and were maintained for six days in a nutrient-controlled environment.

During this early stage, careful observation was conducted to monitor the larvae's growth, feeding behavior, and environmental needs. Optimal temperature and humidity levels were maintained to ensure a high survival rate. The larvae's rapid growth during this phase demonstrated their natural efficiency in converting organic matter into biomass, confirming prior studies such as Diener et al. (2011), which found that BSF larvae can reduce organic waste mass by up to 50–70% within a short time.

B. Activity 2: Preparation of Growth Media

The next phase involved the preparation of the maggot's growth media. Organic waste was collected from various areas in Bima Regency, West Nusa Tenggara, and brought to the cultivation site for processing. The waste included leftover vegetables, fruit peels, spoiled food, and other biodegradable materials commonly produced by households and traditional markets.

The collected waste was then sorted to remove any inorganic contaminants such as plastics or metals. After sorting, the waste was crushed and mixed with water until it formed a soft, mush-like texture. This step was critical because finely crushed waste allows the larvae to consume the material more efficiently, accelerating the decomposition process.

The organic waste mixture was then placed into feeding trays or bins, where the young maggots were introduced. The maggots immediately began to consume the organic material, producing a noticeable reduction in waste volume within days. Similar findings have been reported by Nguyen et al. (2015), who noted that BSF larvae can significantly reduce food waste volume while producing high-quality compost and protein biomass suitable for animal feed.

C. Activity 3: Growth and Maintenance Phase

After seven days of initial feeding, the maggots were transferred to larger containers to accommodate their increasing size and feeding capacity. They were fed daily with freshly crushed organic waste collected from the market. Regular monitoring was performed to maintain optimal conditions of moisture, temperature, and oxygen levels, as these factors greatly influence maggot growth and waste decomposition efficiency.

Throughout the 21-day rearing period, the maggots consumed large quantities of organic waste. By the third week, the larvae had reached maturity and were ready for harvest. Feeding was stopped to allow the larvae to enter the pre-pupal stage, at which point they are rich in protein and fat—making them ideal for use as livestock feed.

According to Sheppard et al. (2002), mature BSF larvae contain approximately 42% protein and 35% fat, providing a valuable source of nutrition for poultry, fish, and other livestock. The harvested larvae were dried and stored for later use as animal feed. This process not only contributed to reducing organic waste but also generated a potential source of income for market traders who participated in the program.

The success of maggot cultivation was evident in several key outcomes. First, the amount of organic waste accumulated in Parung Traditional Market decreased significantly. Since organic waste was needed daily as maggot feed, the constant collection and processing of waste prevented the buildup of unsanitary waste piles. As a result, the market environment became noticeably cleaner and more comfortable for both sellers and buyers.

Second, the maggot cultivation project provided an additional economic opportunity for the market community. Traders and local residents involved in collecting and managing organic waste were able to generate income from selling harvested maggots as animal feed. The dual benefit—reducing waste and creating economic value—demonstrated the project's potential for replication in other traditional markets in Indonesia.

Third, maggot compost residue (known as frass) also proved valuable as organic fertilizer. This byproduct enriched with nutrients such as nitrogen, phosphorus, and potassium can be used to enhance soil fertility for agricultural purposes. Studies by Lalander et al. (2019) and Surendra et al. (2020) confirm that BSF waste residue can be safely applied as organic fertilizer, making the process fully circular and sustainable. The research was conducted at Parung Traditional Market, Bogor, over a period of two months. The market was chosen because it represents a typical Indonesian traditional market with high organic waste production, primarily from vegetable and fruit vendors. The target group for this research consisted of traditional market traders and local residents around Parung

Market. These individuals play a central role in waste generation and were therefore directly involved in the waste collection and maggot cultivation process.

Methodology:

The study applied an observational method by monitoring the entire process of maggot cultivation—from egg collection and hatching to feeding and harvesting. Interviews were also conducted with traders and buyers to gather feedback about the cleanliness and comfort of the market before and after the program.

Additionally, practical training sessions were held for traders on how to separate organic and inorganic waste effectively. The research team provided containers and basic equipment for maggot cultivation, ensuring that participants could continue the process independently after the research period ended.

Success Indicators: The main indicators of success included:

1. A measurable decrease in the accumulation of organic waste within the market area.
2. Improvement in the market's cleanliness and odor levels.
3. Increase in trader income from the sale of maggots and compost residue.

Positive feedback from traders and customers regarding market hygiene.

Quantitatively, waste volume in the market decreased by approximately 60% during the two-month observation period. Traders reported that the area around their stalls smelled fresher and was more comfortable for business. Additionally, maggot sales generated extra income for participating traders—an average of IDR 500,000 per month from maggot feed production. Evaluation was conducted by reanalyzing the biological characteristics of the maggot and the efficiency of the organic waste decomposition process. The research team also organized seminars and workshops for traders and local authorities to discuss improvements in waste collection, handling, and processing.

Based on field observations and participant feedback, several recommendations were formulated to improve and sustain the future implementation of maggot cultivation programs in traditional markets. The first recommendation is to establish permanent maggot cultivation facilities near traditional markets. This step is essential to ensure that organic waste management can be carried out efficiently and continuously. By having a permanent facility, organic waste from traders can be directly processed on-site, reducing the accumulation of waste that usually emits unpleasant odors and attracts disease-carrying pests. Moreover, the proximity of these facilities will make it easier for market traders and workers to participate in waste sorting and processing activities, fostering a sense of shared responsibility for environmental cleanliness.

The second recommendation emphasizes the need to encourage active involvement from local governments, particularly in terms of funding and technical support. Local governments play a strategic role in ensuring the sustainability of waste management programs. They can provide subsidies, infrastructure support, and policy frameworks that facilitate community participation. Additionally, technical support from environmental and agricultural departments can enhance the effectiveness of maggot cultivation through training, supervision, and research collaboration.

Finally, the training program should be expanded to other markets in the Bogor region and eventually replicated in other cities. The success of maggot cultivation in one market can serve as a model for sustainable organic waste management across regions. By expanding this program, more communities can benefit economically through maggot farming while contributing to cleaner, healthier market environments. Ultimately, these initiatives will support broader environmental sustainability goals and promote community-based eco-innovation.

CONCLUSION

Traditional markets play a vital role in the daily lives of communities, serving as centers of economic activity where people trade basic necessities such as vegetables, fruits, meats, and other food items. However, these markets also generate large amounts of organic waste that, if not managed properly, can cause serious environmental and health problems. The accumulation of organic waste—composed of decomposing food materials—produces unpleasant odors, attracts pests, and creates unsanitary conditions that disturb both traders and visitors. Moreover, unmanaged organic waste contributes to environmental pollution, including the release of methane gas, which worsens air quality and contributes to climate change. Therefore, it becomes imperative to find effective, sustainable, and economically viable methods for managing organic waste, particularly in traditional market environments.

The study highlights *maggot cultivation* as an innovative and environmentally friendly approach to organic waste management. Maggot cultivation utilizes the larvae of the *Black Soldier Fly* (*Hermetia illucens*), which are capable of efficiently decomposing organic materials. Unlike common houseflies, *Black Soldier Flies* do not spread diseases or harmful bacteria; in fact, their larvae help transform organic waste into nutrient-rich compost while simultaneously producing high-protein biomass. This process not only reduces the volume of waste significantly but also converts it into valuable resources such as animal feed and organic fertilizer. Therefore, maggot cultivation aligns with the principles of the circular economy, where waste materials are repurposed into productive outputs that support both environmental and economic sustainability.

The implementation of maggot-based waste management in traditional markets offers multiple benefits. Environmentally, it reduces the accumulation of organic waste and mitigates the odor and sanitation problems that typically plague traditional markets. Economically, it provides new sources of income for traders, farmers, and local entrepreneurs. Maggots can be harvested and sold as feed for poultry, fish, and other livestock, as they contain high levels of protein and fat essential for animal growth. Additionally, the residue produced after maggot cultivation—often called *frass*—can be processed into organic fertilizer, which is beneficial for crop cultivation. Thus, the system not only solves the waste problem but also strengthens local economies through value-added products derived from previously discarded materials.

From a social perspective, maggot cultivation has the potential to increase community awareness about waste management and environmental responsibility. By involving local traders, market managers, and residents in maggot cultivation, communities become active participants in reducing pollution and creating cleaner, healthier surroundings. This participatory approach fosters a sense of shared responsibility and cooperation, transforming waste management from a burdensome task into a community-driven initiative with tangible rewards. Over time, such practices can cultivate environmental literacy, encouraging people to adopt sustainable habits not only in markets but also in households and other public spaces.

In the case of the Parung Traditional Market in Bogor, where this research was conducted, maggot cultivation proved to be a practical and successful model for managing organic waste. Through careful observation and collaboration with market traders and waste handlers, the research demonstrated that Black Soldier Fly larvae could decompose large volumes of market waste within days, significantly reducing waste accumulation. Within two months of implementation, noticeable improvements were observed: market cleanliness increased, unpleasant odors were reduced, and traders reported a more comfortable working environment. Furthermore, the sale of harvested maggots and organic fertilizer provided an additional source of income for participants, proving that environmental sustainability can go hand in hand with economic empowerment.

The research also found that maggot cultivation is highly scalable and adaptable to different contexts. With minimal infrastructure requirements, it can be implemented in both rural and urban settings. The process primarily involves preparing suitable organic waste media, maintaining the appropriate temperature and humidity, and providing a conducive environment for Black Soldier Fly breeding. Once established, the system operates efficiently with little supervision and low maintenance costs. This makes it particularly suitable for developing regions and low-income communities that may lack access to advanced waste management technologies.

Moreover, integrating maggot cultivation into broader waste management strategies can contribute to achieving national and global environmental goals. Indonesia, for instance, has committed to reducing waste generation and promoting sustainable practices through various environmental policies. Maggot cultivation can support these initiatives by reducing the volume of organic waste that ends up in landfills, lowering greenhouse gas emissions, and promoting sustainable agriculture through organic fertilizer production. On a global scale, this practice supports the United Nations' Sustainable Development Goals (SDGs), particularly Goal 12 (Responsible Consumption and Production), Goal 13 (Climate Action), and Goal 15 (Life on Land).

However, the success of maggot-based waste management also depends on several key factors, including public awareness, government support, and technical training. Communities need to understand the ecological and economic benefits of maggot cultivation to ensure consistent participation and long-term commitment. Local governments and environmental agencies play a crucial role in providing policy support, technical assistance, and funding for infrastructure development. Training programs and educational workshops should be conducted to teach the proper techniques for maggot cultivation, waste segregation, and product utilization. Without such collaborative efforts, the potential of maggot cultivation as a sustainable waste management solution may not be fully realized.

Furthermore, future research and innovation are needed to optimize maggot farming systems. Studies could explore the nutritional enhancement of maggot feed, the efficiency of waste conversion rates, and the diversification of maggot-derived products. For instance, maggot oil can be extracted for use in cosmetics or biodiesel, and protein powder from maggots can be incorporated into animal feed formulations. These innovations could further increase the economic value of maggot cultivation and expand its potential markets, creating a more resilient and circular bio-economy.

In conclusion, maggot cultivation using *Black Soldier Fly* larvae represents a transformative approach to addressing the persistent problem of organic waste in traditional markets and households. It combines environmental restoration with economic empowerment, turning waste from a burden into a valuable resource. The results from the Parung Traditional Market study clearly demonstrate the effectiveness of this method in reducing organic waste accumulation, improving market sanitation, and generating additional income for local communities. The initiative aligns with sustainable development principles by promoting recycling, reducing pollution, and supporting local livelihoods.

Therefore, it is essential to encourage the wider adoption of maggot cultivation practices across Indonesia and beyond. Government institutions, educational organizations, and community groups should collaborate to integrate maggot farming into public waste management systems and community empowerment programs. By doing so, we can create a cleaner environment, enhance economic opportunities, and move closer to a sustainable future where waste is no longer seen as a problem but as a resource to be managed wisely and productively. Through continued research, education, and community involvement, maggot cultivation can become a cornerstone of sustainable waste management and environmental stewardship for generations to come.

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