

Empowering Communities Through Maggot Management for Livestock Feed and Organic Fertilizer

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Abstract

Organic waste management presents a significant challenge for many communities, especially in the agricultural and livestock sectors. The increasing amount of organic waste, particularly in urban areas, has led to environmental issues such as landfill overflow, methane emissions, and pollution. As an innovative solution, the use of Black Soldier Fly (BSF) larvae has proven effective in converting organic waste into animal feed and organic fertilizers. This study aims to develop a community-based training program focusing on the utilization of BSF larvae for organic waste management and the production of value-added products. The implementation method includes identifying suitable locations, designing the training program, and providing post-training support to participants. Results show that participants successfully applied BSF farming techniques using local organic waste, producing high-quality animal feed and organic fertilizers that enhanced agricultural productivity. Additionally, this technology reduced feed costs, lessened dependence on chemical fertilizers, and minimized the volume of waste disposed of in landfills. The discussion highlights challenges related to infrastructure and the availability of quality organic waste. The main conclusion of the study is that BSF farming provides a sustainable solution that can improve food security, reduce environmental impacts, and strengthen local economies through community empowerment.

INTRODUCTION

The current state of organic waste management across various communities underscores the increasing urgency to

address the challenges posed by rapidly growing levels of waste. The significant rise in urbanization and population has resulted in a marked increase in organic



waste, creating substantial environmental concerns such as landfill overflow, methane emissions, and a depletion of natural resources. Conventional waste management practices, such as landfilling and incineration, exacerbate these issues, contributing not only to pollution but also to global warming. With global food security and agricultural sustainability being key challenges for many nations, the agricultural sector faces increasing pressure to find innovative, sustainable solutions. As part of this growing need for sustainable waste management, the use of bioconversion technologies, particularly the utilization of Black Soldier Fly (*Hermetia illucens*, BSF) larvae, has emerged as a viable solution. Recent studies have highlighted the effectiveness of BSF larvae in converting organic waste into valuable products, including animal feed, biofertilizer, and even biofuels (Amrul et al., 2022; Rehman et al., 2023). This innovative method not only tackles the problem of organic waste disposal but also offers sustainable alternatives for the agricultural sector, especially in providing alternative animal feed and organic fertilizers.

The application of BSF larvae in organic waste management reflects their polyphagous nature, allowing them to degrade a wide variety of organic substrates such as food waste, agricultural by-products, and manure. Studies have demonstrated that BSF larvae can reduce organic waste by up to 80% within 10 to 14 days (Zhang & Puniamoorthy, 2025), making them an efficient solution for waste reduction. Moreover, this bioconversion process contributes to nutrient recovery and promotes a circular economy. In addition to waste reduction, the use of BSF larvae in organic waste management has the added benefit of producing frass, a nutrient-rich residue that serves as a natural fertilizer. The utilization of frass improves soil health, reduces the need for chemical fertilizers, and supports agricultural sustainability, aligning with broader environmental goals (Isibika et al., 2023). Furthermore, BSF larvae can play a critical role in mitigating environmental impacts, such as the emission of greenhouse gases from traditional waste disposal methods, by providing an eco-friendly alternative for waste recycling (Amrul et al., 2022; Jupesta & Permana, 2025).

Despite the promising benefits of BSF farming, several challenges must be addressed to ensure its widespread adoption in local communities, particularly in low- and middle-income countries. One significant challenge is the initial investment required to establish BSF farming systems, including infrastructure for rearing the larvae, waste collection, and processing facilities. For smallholder farmers or communities with limited financial resources, these costs may seem prohibitive (I.-H. Choi, 2024; Sinaga et al., 2024). However, studies have shown that with proper guidance, the decentralization of BSF farming, utilizing locally available organic waste, can reduce costs and offer a feasible, low-investment solution for communities to generate alternative income while also solving waste management problems (Abro et al., 2022; Iqbal et al., 2025). Additionally, the availability and consistency of organic waste streams used as feedstock for BSF larvae can pose challenges. If local waste sources are insufficient or of poor quality, additional costs may arise from procuring alternative organic materials (Sayed et al., 2023). Despite these challenges, the

positive economic implications of BSF farming cannot be overstated, particularly in providing a source of local employment, reducing reliance on costly imported feed, and contributing to enhanced food security (Barrett et al., 2022; Isibika et al., 2023).

The increasing demand for sustainable alternatives in livestock feed and fertilizers has made BSF farming even more relevant. Traditional protein sources for animal feed, such as soybean and fishmeal, face significant sustainability challenges. The production of these conventional feed ingredients often contributes to deforestation, biodiversity loss, and greenhouse gas emissions (J. Lee et al., 2024; Seyedalmoosavi et al., 2023). The rising demand for livestock and aquaculture products necessitates a continuous and reliable protein supply, which cannot solely depend on conventional methods. In this context, BSF larvae provide a promising, sustainable alternative to traditional protein sources. BSF larvae contain up to 55% protein, which is rich in essential amino acids, making them an excellent substitute for more conventional animal feed ingredients like soybean and fishmeal (Crosbie et al.,

2020; Giannetto et al., 2020). Moreover, the residual material from BSF farming, known as frass, is an eco-friendly, nutrient-rich fertilizer that enhances soil health and supports sustainable farming practices (Gärtling & Schulz, 2022; Heussler et al., 2023). The use of BSF larvae in waste management not only addresses environmental concerns but also alleviates the burden on agricultural systems that rely on resource-intensive protein sources.

In addition to providing a sustainable alternative to traditional animal feed, BSF larvae contribute to the reduction of food waste by utilizing agricultural residues and other organic by-products as feedstock. This recycling of nutrients back into the ecosystem promotes the principles of a circular economy, helping communities reduce waste in landfills while simultaneously improving food security through the production of a consistent protein supply for livestock (Choi, 2020). The rapid bioconversion process of BSF larvae, which transforms organic waste into high-protein biomass, offers an efficient solution to the growing concerns regarding food waste and resource depletion. Moreover, BSF farming is an

economically viable method of waste reduction that requires relatively low resources, such as land, water, and infrastructure, in comparison to conventional livestock feed production (Heussler et al., 2023; Mulyani et al., 2024).

Another significant advantage of BSF larvae farming is its relatively low environmental footprint compared to traditional livestock farming. The process of rearing BSF larvae on organic waste reduces land and water consumption while emitting fewer greenhouse gases, making it an attractive alternative in an era focused on sustainability and reducing environmental impacts (Broeckx et al., 2021). Furthermore, BSF larvae have been shown to exhibit antimicrobial properties, helping to reduce pathogens such as *Salmonella* and *E. coli*, which are commonly found in conventional livestock feed (Shu et al., 2024). This aspect of BSF larvae farming enhances the safety and quality of animal products, which is particularly important in regions with higher risks of pathogen transmission in animal husbandry.

The integration of BSF larvae farming into the agricultural and waste

management systems of communities offers significant environmental benefits, but it also presents a unique economic opportunity. Training programs that focus on maggot farming can empower communities to establish and manage BSF farming systems, providing new sources of income while improving local economies. Educating farmers about the benefits of BSF larvae farming, both for waste management and as a source of sustainable feed and fertilizers, can create new entrepreneurial opportunities and support the development of micro-enterprises (Mutuku et al., 2022; Yuwono et al., 2021). Additionally, raising awareness about the nutritional benefits of insect-based feed can help communities capitalize on emerging market trends as consumers become more conscious of the environmental impacts of traditional livestock production (Opare et al., 2022; Ouko et al., 2022).

Several successful case studies have demonstrated the viability of BSF farming in various regions, providing evidence of its potential to address local environmental and economic challenges. For example, research conducted in West Jakarta, Indonesia, showed the successful

implementation of BSF farming to reduce food waste and provide local communities with a sustainable source of protein and fertilizer (Oemar et al., 2023). Similarly, studies in aquaculture have shown that BSF larvae-based feed improves profitability in fish farming, such as with Nile Tilapia (*Oreochromis niloticus*), without compromising growth performance (Wachira et al., 2021). These successful cases underscore the potential of BSF farming to enhance food security, promote sustainable waste management, and provide a sustainable livelihood for local communities.

In conclusion, BSF farming offers a multifaceted solution to contemporary challenges in waste management, livestock feed production, and agricultural sustainability. The environmental benefits of using BSF larvae for organic waste recycling, coupled with the potential to provide alternative protein sources for animal feed and organic fertilizers, make it an attractive option for communities seeking sustainable solutions. Through the integration of BSF farming into local agricultural practices and waste management systems, communities can address pressing environmental and

economic issues while promoting sustainable agricultural practices that contribute to broader goals of food security and environmental protection. The success of training programs and local initiatives will be pivotal in maximizing the potential of BSF farming as a tool for community empowerment and sustainable development.

METHOD

The effective management of organic waste is a growing challenge for many communities, especially in agricultural and livestock sectors where waste accumulation is often significant. Traditional waste disposal methods such as landfill and incineration have detrimental environmental impacts, contributing to greenhouse gas emissions, including methane (Amrul et al., 2022). As an innovative solution, the use of Black Soldier Fly (*Hermetia illucens*) larvae in organic waste bioconversion offers an environmentally sustainable method for reducing waste while producing valuable by-products such as animal feed and organic fertilizers (Rehman et al., 2023). This research aims to develop and assess a community-based training program that focuses on utilizing Black Soldier Fly

larvae for managing organic waste and creating value-added products, with an emphasis on both environmental

Methodology of Implementation

The methodology for this community-based intervention will be divided into several key components. These steps include the identification and selection of the project location, the design of the training approach, and the post-training support provided to participants. The methodology follows a structured process that integrates technical training, waste management education, and practical support to ensure that participants can effectively apply the knowledge gained.

A. Identification and Selection of Location

The first step in the methodology is identifying and selecting the appropriate location for the implementation of the community-based training program. The location will be chosen based on the following criteria:

1. **Agricultural and Livestock Potential:** The target area should have active agricultural and livestock activities facing organic waste management challenges.

Communities engaged in farming and livestock breeding would benefit most from Black Soldier Fly farming as a waste management and value creation tool.

2. **Need for Organic Waste Management Solutions:** The selected area should have available organic waste, like food waste, agricultural residues, and animal manure, for BSF farming. The program will tackle waste management issues and enhance the sustainability of agricultural practices (Isibika et al., 2023).

B. Training Approach

The training program will consist of three core modules offering both theoretical and practical knowledge to participants, equipping them with the skills to manage organic waste through Black Soldier Fly (BSF) larvae farming.

1. **Technical Training on Maggot Farming**

This module will cover:

- a. **Stages of Maggot Farming:** Participants will learn the lifecycle of BSF larvae, including rearing, harvesting, substrate

preparation, and larvae feeding (Mulianda et al., 2021).

- b. **Environmental Needs of Maggots:** Focus on creating optimal conditions for BSF growth, including temperature, humidity, and growth media (Lievens et al., 2021).
- c. **Benefits of Maggots:** BSF larvae as a sustainable protein source for animal feed and organic fertilizer, with the larvae's frass serving as high-value fertilizer (Hoffmann et al., 2021; Zhang & Puniamoorthy, 2025).

2. **Organic Waste Management Training**

This module will include:

- a. **Managing Organic Waste for Maggot Rearing:** Techniques for collecting and processing organic waste like food, agricultural residues, and manure for BSF larvae rearing (Rimantho et al., 2022).
- b. **Waste-to-Feed Conversion:** How organic waste is converted into animal feed through bioconversion, emphasizing environmental

and economic benefits (Belperio et al., 2024).

3. Training on Organic Fertilizer Utilization

This module will focus on:

- a. Processing Maggot Waste into Organic Fertilizer: Converting maggot waste (frass) into quality organic fertilizer, with practical exercises to improve soil health (Beesigamukama et al., 2022).
- b. Utilizing Organic Fertilizer in Agriculture: Best practices for applying BSF-produced fertilizer to boost agricultural productivity and reduce reliance on chemical fertilizers (Gärttling & Schulz, 2022).

C. Post-Training Support

To ensure the success and sustainability of BSF farming practices, continuous support will be provided to participants after the training. This includes field visits, follow-up support, and business plan development for establishing sustainable BSF farms. The post-training support aims to help

participants implement their knowledge and overcome challenges.

1. **Field Visits for Monitoring and Support**

Field visits will be conducted to assess the progress of participants' BSF farms. Trainers will offer guidance on improving practices and provide solutions for any challenges in farm operation (Akanda et al., 2025). These visits will also allow participants to ask questions and receive technical support.

2. **Business Development Planning**

Participants will receive guidance in developing a business plan for their BSF farms, including advice on marketing BSF larvae and frass as animal feed and fertilizer. The plan will focus on the financial aspects, such as cost analysis, pricing, and revenue potential (Abro et al., 2022).

3. **Ongoing Mentorship and Networking**

Participants will be connected to local agricultural cooperatives, NGOs, and relevant stakeholders, ensuring ongoing

mentorship and knowledge exchange. This network will provide continued support and a platform for sharing best practices in BSF farming (Guilliet et al., 2022).

4. Policy Advocacy for Insect Farming Support

Participants will be encouraged to engage with local policymakers to advocate for policies supporting BSF larvae in waste management and agriculture. The training will include an advocacy component to help participants communicate the benefits of BSF farming effectively (Lagman-Bautista, 2020).

RESULT & DISCUSSION

Result

The training on maggot farming (Black Soldier Fly/BSF larvae) began with a theoretical session attended by participants from various backgrounds. They gained basic knowledge about the benefits of BSF larvae in organic waste management and their use as animal feed and organic fertilizer. The instructor provided explanations through slide presentations that covered

basic techniques in maggot farming and the ecological and economic benefits of this technology.



Figure 1 Maggot Farming Training

The following image shows the situation in the training classroom, where participants eagerly followed the session guided by the instructor.

Implementation of Maggot Farming (BSF Larvae)

After the training, participants successfully implemented the techniques taught in maggot farming. Most participants were able to start BSF farming independently using local organic waste as raw material. They successfully managed the lifecycle of BSF larvae, from maintenance to harvesting, by utilizing the appropriate temperature, humidity, and growing media.

However, some participants faced challenges in managing infrastructure and maintaining optimal environmental

conditions, particularly during certain seasons that affected humidity and temperature. Nevertheless, the results showed that maggot farming can be done at a relatively low cost compared to conventional farming systems, as participants made use of locally available organic waste. Additionally, the maggot production can be utilized as high-protein animal feed, providing a more economical and environmentally friendly feed alternative.

Production of Organic Fertilizer from Maggot Waste

Participants also successfully processed maggot waste (frass) into organic fertilizer that is useful for improving soil fertility. This process demonstrated the potential of frass as a nutrient-rich fertilizer that can enhance the quality of their agricultural soils. Some participants reported that using organic fertilizer from maggots resulted in better agricultural yields compared to chemical fertilizers, with richer soil and healthier plants.



Figure 2 Maggot Waste Fertilizer

The organic fertilizer produced has the advantage of reducing dependence on chemical fertilizers, which are often more expensive and have a negative impact on the environment. However, the challenge faced in producing organic fertilizer from maggots is the lack of knowledge and skills in optimal frass processing. Therefore, more practical training is required to ensure proper processing.

Economic and Environmental Impacts

Economically, maggot farming provides significant benefits for the training participants. Many of them were able to reduce livestock feed expenses by replacing some traditional feed with maggots. This also opened up new business opportunities for the community, such as marketing maggot feed and organic fertilizer. Participants managing BSF farming businesses

reported increased income, especially for small-scale farmers who previously spent a lot on imported livestock feed.

From an environmental perspective, this program successfully reduced the amount of organic waste sent to landfills or burned openly, which previously contributed to air pollution and greenhouse gas emissions. Through the use of BSF larvae, organic waste can be managed in a more environmentally friendly way, producing value-added products.

Discussion

The results obtained from the implementation of maggot farming and organic fertilizer production indicate that bioconversion technology using BSF larvae has great potential in managing organic waste and enhancing food security at the community level. This study found that maggot farming is not only effective in reducing the volume of organic waste but also has the potential to improve agricultural and livestock productivity through the use of alternative animal feed and more environmentally friendly organic fertilizers.

These results align with previous studies that show that BSF larvae can

reduce organic waste by up to 80% in a short period while producing high-nutrient products such as animal feed and organic fertilizers that support agricultural sustainability (Amrul et al., 2022; Isibika et al., 2023). Furthermore, using maggots as animal feed replaces more expensive traditional feed ingredients, such as soybeans and fish, which have a larger environmental impact (Lee et al., 2024).

However, the challenges faced by participants in the implementation of maggot farming are related to the initial investment required for infrastructure and the maintenance of appropriate environmental conditions. Some small-scale farmers still struggle to access the necessary facilities for optimal BSF management, which requires more attention in planning and executing future training programs. Therefore, it is crucial to provide sustained support to participants after the training to ensure long-term success and the widespread adoption of this technology in the community (Mulyanti et al., 2025).

From an environmental perspective, although maggot farming can reduce organic waste and greenhouse gas emissions, the

widespread adoption of this technology still faces challenges related to the availability of quality organic waste that can be consistently used as raw material. Additionally, to increase community awareness and acceptance of this technology, further educational campaigns are needed to highlight the ecological and economic benefits of using BSF larvae in waste management.

CONCLUSION

In conclusion, the implementation of maggot farming using BSF larvae has proven to be an effective and sustainable solution for managing organic waste, enhancing food security, and improving agricultural productivity. By utilizing locally available organic waste, this technology offers an affordable, environmentally friendly alternative to traditional animal feed and chemical fertilizers. Despite some challenges related to infrastructure and the availability of consistent organic waste, the potential benefits of BSF farming – both economically and environmentally – highlight its value in promoting sustainable agricultural practices and community empowerment. Continued support and education are essential to

ensure the long-term success and broader adoption of this technology.

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REFERENCES

- Abro, Z., Macharia, I., Mulungu, K., Subramanian, S., Tanga, C. M., & Kassie, M. (2022). The potential economic benefits of insect-based feed in Uganda. *Frontiers in Insect Science*, 2. <https://doi.org/10.3389/finsc.2022.968042>
- Akanda, M. A. B. R., Hashem, S., Roy, P., Haque, M. M., & Salam, M. A. (2025). Black soldier fly farming in Bangladesh: current practices, farmer's challenges and future opportunities. *Journal of Insects as Food and Feed*. <https://doi.org/10.1163/23524588-00001450>
- Amrul, N. F., Ahmad, I. K., Basri, N. E. A., Suja, F., Jalil, N. A. A., & Azman, N. A. (2022). A Review of Organic Waste Treatment Using Black Soldier Fly (*Hermetia illucens*). *Sustainability (Switzerland)*, 14(8). <https://doi.org/10.3390/su14084565>

- Barrett, M., Godfrey, R. K., Sterner, E. J., & Waddell, E. A. (2022). Impacts of development and adult sex on brain cell numbers in the Black Soldier Fly, *Hermetia illucens* L. (Diptera: Stratiomyidae). *Arthropod Structure and Development*, 70. <https://doi.org/10.1016/j.asd.2022.101174>
- Beesigamukama, D., Mochoge, B., Korir, N., Menale, K., Muriithi, B., Kidoido, M., Kirscht, H., Diiro, G., Ghemoh, C. J., Sevgan, S., Nakimbugwe, D., Musyoka, M. W., Ekesi, S., & Tanga, C. M. (2022). Economic and ecological values of frass fertiliser from black soldier fly agro-industrial waste processing. *Journal of Insects as Food and Feed*, 8(3), 245 - 254. <https://doi.org/10.3920/JIFF2021.0013>
- Belperio, S., Cattaneo, A., Nannoni, E., Sardi, L., Martelli, G., Dabbou, S., & Meneguz, M. (2024). Assessing Substrate Utilization and Bioconversion Efficiency of Black Soldier Fly (*Hermetia illucens*) Larvae: Effect of Diet Composition on Growth and Development Temperature. *Animals*, 14(9). <https://doi.org/10.3390/ani14091340>
- Broeckx, L., Frooninckx, L., Slegers, L., Berrens, S., Noyens, I., Goossens, S., Verheyen, G., Wuyts, A., & Van Miert, S. (2021). Growth of black soldier fly larvae reared on organic side-streams. *Sustainability (Switzerland)*, 13(23). <https://doi.org/10.3390/su132312953>
- Choi, I.-H. (2024). Evaluation of the decomposition ability and characteristics of pig manure treated with different larval instar stages of black soldier fly (*Hermetia illucens* L.). *Entomological Research*, 54(4). <https://doi.org/10.1111/1748-5967.12731>
- Choi, J.-S. (2020). Patents on insect-based feeds for animals including companion animals, and terrestrial and aquatic livestock in Korea. *Recent Patents on Food, Nutrition and Agriculture*, 11(1), 3 - 12. <https://doi.org/10.2174/2212798410666190617160844>
- Crosbie, M., Zhu, C., Shoveller, A. K., & Huber, L.-A. (2020). Standardized ileal digestible amino acids and net energy contents in full fat and defatted black soldier fly larvae meals (*Hermetia illucens*) fed to growing pigs. *Translational Animal Science*, 4(3), 1 - 10. <https://doi.org/10.1093/tas/txaa104>
- Gärttling, D., & Schulz, H. (2022). Compilation of Black Soldier Fly Frass Analyses. *Journal of Soil Science and Plant Nutrition*, 22(1), 937 - 943. <https://doi.org/10.1007/s42729-021-00703-w>
- Giannetto, A., Oliva, S., Riolo, K., Savastano, D., Parrino, V., Cappello, T., Maisano, M., Fasulo, S., & Mauceri, A. (2020). Waste valorization via *hermetia illucens* to produce protein-rich biomass for feed: Insight into the critical nutrient taurine. *Animals*, 10(9), 1 - 17.

- <https://doi.org/10.3390/ani10091710>
- Guilliet, J., Baudouin, G., Pollet, N., & Filée, J. (2022). What complete mitochondrial genomes tell us about the evolutionary history of the black soldier fly, *Hermetia illucens*. *BMC Ecology and Evolution*, 22(1).
<https://doi.org/10.1186/s12862-022-02025-6>
- Heussler, C. D., Insam, H., Walter, A., Steiner, B. C. S., Steiner, F. M., & Klammsteiner, T. (2023). Life-history traits of black soldier fly reared on agro-industrial by-products subjected to three pre-treatments: a pilot-scale study. *Journal of Insects as Food and Feed*, 9(5), 545 - 556.
<https://doi.org/10.3920/JIFF2022.0044>
- Hoffmann, L., Hull, K. L., Bierman, A., Badenhorst, R., der Merwe, A. E., & Rhode, C. (2021). Patterns of genetic diversity and mating systems in a mass-reared black soldier fly colony. *Insects*, 12(6).
<https://doi.org/10.3390/insects12060480>
- Iqbal, W., Elahi, U., Zhang, H.-J., Ahmad, S., Usman, M., & Yaqoob, M. U. (2025). Clean and Green Bioconversion - A Comprehensive Review on Black Soldier Fly (*Hermetia illucens*) Larvae for Converting Organic Wastes to Quality Products. *Annals of Animal Science*, 25(1), 57 - 81.
<https://doi.org/10.2478/aoas-2024-0046>
- Isibika, A., Simha, P., Vinnerås, B., Zurbrügg, C., Kibazohi, O., & Lalander, C. (2023). Food industry waste - An opportunity for black soldier fly larvae protein production in Tanzania. *Science of the Total Environment*, 858.
<https://doi.org/10.1016/j.scitoten.v.2022.159985>
- Jupesta, J., & Permana, I. (2025). Organic Waste Management in Tasikmalaya City, Indonesia. *Lecture Notes in Civil Engineering*, 559 LNCE, 286 - 294. https://doi.org/10.1007/978-981-97-8401-1_20
- Lagman-Bautista, J. (2020). CRAFTING A THEORETICAL FRAMEWORK ON WASTE MANAGEMENT: A CASE FOR SUSTAINABLE CITIES. *International Journal of GEOMATE*, 18(68), 80 - 86.
<https://doi.org/10.21660/2020.68.5683>
- Lee, H. N., Yeom, G. L., Kim, Y. B., Yum, K. H., Park, J. Y., Lee, W. T., Seo, H. S., Lee, S. Y., & Kim, J. H. (2024). Prospects of using insects as alternative protein sources in broiler diets. *Journal of Insects as Food and Feed*, 10(12), 2107 - 2141.
<https://doi.org/10.1163/23524588-00001140>
- Lee, J., Park, Y., Song, D., Chang, S., & Cho, J. (2024). Effects of Defatted and Hydrolyzed Black Soldier Fly Larvae Meal as an Alternative Fish Meal in Weaning Pigs. *Animals*, 14(11).
<https://doi.org/10.3390/ani14111692>
- Lievens, S., Poma, G., De Smet, J., Van Campenhout, L., Covaci, A., & Van Der Borght, M. (2021). Chemical Safety of Black Soldier Fly Larvae (*Hermetia Illucens*), Knowledge

- Gaps and Recommendations for Future Research: a Critical Review. *Journal of Insects as Food and Feed*, 7(4), 383 - 396. <https://doi.org/10.3920/JIFF2020.0081>
- Mulianda, R., Sofyan, A., Herdian, H., Laconi, E. B., Ridla, M., Wardani, W. W., & Jayanegara, A. (2021). In sacco nutrient degradability of silage containing intact and defatted black soldier fly (*Hermetia illucens*) larvae. *Journal of the Indonesian Tropical Animal Agriculture*, 46(3), 227 - 235. <https://doi.org/10.14710/jitaa.46.3.227-235>
- Mulyani, I., Fatkhullah, M., Reihan, A., & Agustawan. (2024). Transforming Coastal Communities to Adapt Climate Change through Corporate Social Responsibility. *IOP Conference Series: Earth and Environmental Science*, 1321(1). <https://doi.org/10.1088/1755-1315/1321/1/012055>
- Mulyanti, D. R., Alfikri, M. R., Ana, A. P., Sitohang, E. J., Chandra, A., Noviyanto, D., & Wibowo, A. C. (2025). Utilizing Black Soldier Fly Larvae for Sustainable Organic Waste Management and Urban Farming: Efficiency, Challenges, and Scalability. 4(1), 152-161.
- Mutuku, K. V, Mukhebi, A. W., Orinda, M. A., & Tanga, C. M. (2022). Determinants of profitability of black soldier fly farming enterprise in Kenya. *Journal of Insects as Food and Feed*, 8(6), 693 - 699. <https://doi.org/10.3920/JIFF2021.0066>
- Oemar, T., Purwaningrum, P., Ruhayat, R., & Ashardiono, F. (2023). POTENTIAL OF BLACK SOLDIER FLY (BSF) IN REDUCING MUNICIPAL FOOD LOSS AND WASTE (FLW) AT TAMAN SARI DISTRICT, WEST JAKARTA. *Indonesian Journal of Urban and Environmental Technology*, 6(2), 132 - 144. <https://doi.org/10.25105/urbanenvirotech.v6i2.16932>
- Opore, L. O., Holm, S., & Esperk, T. (2022). Temperature-modified density effects in the black soldier fly: low larval density leads to large size, short development time and high fat content. *Journal of Insects as Food and Feed*, 8(7), 783 - 802. <https://doi.org/10.3920/JIFF2021.0147>
- Ouko, K. O., Mukhebi, A. W., Obiero, K. O., Opondo, F. A., Ngo'ng'a, C. A., & Ongor, D. O. (2022). Stakeholders' perspectives on the use of black soldier fly larvae as an alternative sustainable feed ingredient in aquaculture, Kenya. *African Journal of Agricultural and Resource Economics*, 17(1), 64 - 79. [https://doi.org/10.53936/AFJARE.2022.17\(1\).4](https://doi.org/10.53936/AFJARE.2022.17(1).4)
- Rehman, K. ur, Hollah, C., Wiesotzki, K., Rehman, R. ur, Rehman, A. U., Zhang, J., Zheng, L., Nienaber, T., Heinz, V., & Aganovic, K. (2023). Black soldier fly, *Hermetia illucens* as a potential innovative and environmentally friendly tool for organic waste management: A mini-review. *Waste Management and Research*, 41(1), 81 - 97.

- <https://doi.org/10.1177/0734242X221105441>
- Rimantho, D., Hidayah, N. Y., Saputra, A., Chandra, A., Rizkiya, A. N., Nashifah, G., Fitriyani, P., & Wesha, D. M. P. (2022). Material Flow Analysis for Assessing the Sustainability Solid Waste Management Strategy. *International Journal of Sustainable Development and Planning*, 17(7), 2271 - 2278. <https://doi.org/10.18280/ijstdp.170728>
- Sayed, W. A. A., Alm-Eldin, M. M. S., Hassan, R. S., Sileem, T. M., & Rumpold, B. A. (2023). Recycling of Mediterranean Fruit Fly Rearing Waste by Black Soldier Fly, *Hermetia illucens*. *Waste and Biomass Valorization*, 14(1), 93 - 104. <https://doi.org/10.1007/s12649-022-01847-1>
- Seyedalmoosavi, M. M., Dannenberger, D., Pfuhl, R., Görs, S., Mielenz, M., Maak, S., Wolf, P., Daş, G., & Metges, C. C. (2023). Lipid metabolism, fatty acid composition and meat quality in broilers supplemented with increasing levels of defrosted black soldier fly larvae. *Journal of Insects as Food and Feed*, 9(5), 583 - 598. <https://doi.org/10.3920/JIFF2022.0125>
- Shu, M. K., Li, C. M., Furtado, W. E., Huang, Q., St-Hilaire, S., & Kenéz, Á. (2024). Antibacterial properties of oil extracts of black soldier fly larvae reared on bread waste. *Animal Production Science*, 64(8). <https://doi.org/10.1071/AN23394>
- Sinaga, A. R., Sembada, P., Ayuningtyas, G., Kusumanti, I., Bachtiar, W., & Riyanti, L. (2024). Integrated model to support a sustainable farming system: utilization of Black Fly Soldier (BSF) as bioconversion agent. *BIO Web of Conferences*, 123. <https://doi.org/10.1051/bioconf/202412303001>
- Yuwono, A. S., Permana, I. G., Nurulalia, L., & Mentari, P. D. (2021). Decomposition characteristics of selected solid organic wastes by black soldier fly (Bsf) larvae as affected by temperature regimes. *Polish Journal of Environmental Studies*, 30(5), 4343 - 4352. <https://doi.org/10.15244/pjoes/131865>
- Zhang, Q.-H., & Puniamoorthy, N. (2025). Impact of Rearing Substrates on Black Soldier Fly Growth and Fertility: A Semi-Industrial Scale Study to Optimize Egg Collection. *Insects*, 16(2). <https://doi.org/10.3390/insects16020142>