

# MAGGOT-BASED CIRCULAR AGRICULTURE FOR ECONOMIC STRENGTHENING AND SUSTAINABLE WASTE MANAGEMENT IN KERTAWANGI TOURISM VILLAGE, WEST BANDUNG REGENCY

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## Absract

The growing volume of organic waste in tourism villages poses a significant challenge to sustainable tourism development. Kertawangsi Tourism Village in West Bandung Regency, as a community-based tourism destination, faces the problem of unmanaged household organic waste accumulation. This study aims to analyze the implementation of a circular agriculture dissemination and training program based on Black Soldier Fly (BSF) maggot cultivation, aimed at strengthening the local economy and promoting sustainable organic waste management. The study employed a descriptive qualitative approach using participatory observation, in-depth interviews, activity documentation, and direct involvement in program implementation. Findings indicate that practice-based training effectively enhanced community understanding of circular economy principles, BSF cultivation techniques, and value-added organic waste management. The program also promoted environmental awareness, created green entrepreneurship opportunities, and demonstrated potential for developing Kertawangsi Tourism Village into an environmental education tourism destination within the community-based tourism framework. The study concludes that BSF maggot cultivation can serve as a replicable community-based organic waste management model, contributing to circular economy development and sustainable tourism at the village level.

**Keywords:** Black Soldier Fly, Circular Economy, Community Empowerment, Organic Waste Management, Sustainable Tourism, Tourism Village.

## A. INTRODUCTION

Organic waste management is one of the fundamental challenges in sustainable development, particularly in areas experiencing simultaneous growth in community activities and tourism. Data from the Indonesian Ministry of Environment and Forestry (KLHK, 2022) indicate that the national waste composition is still dominated by organic waste originating from households, traditional markets, and urban consumption activities.

This condition highlights the urgent need for more innovative, participatory, and biotechnology-based approaches to waste management.

In the context of tourism village development, waste management is not merely an issue of environmental cleanliness but also a determining factor influencing destination quality, visitor comfort, and the overall image of a tourism area. Mulyani and Hidayat (2020) emphasized that the growth of tourism activities without an adequate waste management system can lead to environmental degradation, ultimately reducing the attractiveness and competitiveness of a destination. Therefore, community-based waste management is regarded as one of the key strategies for supporting sustainable tourism development.

One approach that has gained increasing attention in organic waste management is the concept of the circular economy. Unlike the linear economic model, which follows a “take–make–dispose” pattern, the circular economy prioritizes resource reuse and the transformation of waste into products with economic value (Kirchherr et al., 2017). A practical implementation of this concept in organic waste management is through the bioconversion process using Black Soldier Fly (BSF) larvae (*Hermetia illucens*), commonly known as BSF maggots.

BSF maggots possess a high capacity for organic waste bioconversion and have been scientifically proven to significantly reduce waste volume within a relatively short period (Diener et al., 2011). In addition, BSF larval biomass contains high levels of protein, making it a viable alternative livestock feed, while the solid residue produced from the bioconversion process (*frass* or *kasgot*) can be utilized as high-quality organic fertilizer (Makkar et al., 2014). Thus, BSF maggot cultivation represents a complete circular value chain, transforming waste into economically valuable products.

Kertawangi Tourism Village, located in Cisarua District, West Bandung Regency, is one of the tourism areas based on agriculture and nature with considerable development potential. Most of its residents depend on agriculture, livestock farming, and agro-tourism, which indirectly generate substantial volumes of organic waste on a daily basis. The issue of inadequately managed household organic waste became the primary background for designing the Dissemination and Training Program on Maggot-Based Circular Agriculture in the village.

This activity was part of a community service program conducted by graduate students of the Applied Postgraduate Program in Tourism Planning and Development at the NHI Bandung Tourism Polytechnic. The program was designed not only as a knowledge-transfer initiative but also as a community empowerment effort aimed at utilizing organic waste as an economic resource. In the long term, the program is expected to support the transformation of Kertawangi Tourism Village into a sustainable environmental education tourism destination. Based on the background described above, this study aims to:

- Analyze the implementation of the maggot-based circular agriculture training program in Kertawangi Tourism Village;
- Identify the environmental and economic impacts generated by the training program; and

- Evaluate the potential of the program in supporting community-based sustainable tourism development.

## **B. LITERATURE REVIEW**

### **Circular Economy in the Context of Waste Management**

The circular economy is a development concept designed to replace the linear economic paradigm by maximizing the utility and value of resources over the long term. In this system, waste is no longer viewed as an end product to be discarded but rather as a raw material that can be reintroduced into the production cycle (Ellen MacArthur Foundation, 2013). This approach has gained global relevance due to increasing pressure on natural resources and the diminishing capacity of waste processing systems.

Through a comprehensive analysis of 114 definitions, Kirchherr et al. (2017) define the circular economy as an economic system that minimizes the consumption of primary resources and waste generation through the repeated use of materials within biological and technical loops. In the field of organic waste management, biological loops can be realized through bioconversion technologies, composting, or biogas production. The application of circular economy principles at the community level, particularly in tourism villages, is considered capable of creating new economic value while simultaneously preserving environmental quality.

Sari and Kurniawan (2022), in their study on the implementation of circular economy principles in community-based waste management, found that integrating circular practices into village-level waste management systems significantly reduces dependence on landfills while creating alternative income opportunities for local communities. These findings reinforce the argument that a circular economy approach provides not only ecological benefits but also substantial economic advantages.

### **Black Soldier Fly (BSF) Cultivation as a Bioconversion Agent**

The Black Soldier Fly (BSF) (*Hermetia illucens*) is an insect belonging to the Stratiomyidae family, whose larvae are recognized as highly effective agents for organic waste bioconversion. BSF larvae are capable of decomposing a wide range of organic materials, including food waste, animal manure, and agricultural residues, through biological processes that produce minimal harmful emissions (Diener et al., 2011). This high bioconversion capacity makes BSF an environmentally friendly and productive solution for waste management.

From a nutritional perspective, BSF maggots contain approximately 40–50% crude protein, high lipid content, and a relatively complete amino acid profile. Makkar et al. (2014) reported that BSF larvae can serve as a partial substitute for fishmeal and soybean meal in poultry and aquaculture feed formulations, thereby reducing production costs in the livestock and aquaculture sectors.

In addition to the larvae themselves, the by-product known as frass or kasgot (maggot castings) serves as an organic fertilizer rich in nitrogen, phosphorus, and potassium. Yuwono and Mentari (2022) noted that the use of kasgot in agriculture can improve soil fertility sustainably and reduce farmers' dependence on synthetic chemical fertilizers. Consequently, BSF cultivation creates a complete circular value chain in which organic

waste is converted into high-quality animal feed and organic fertilizer, simultaneously supporting both agricultural and livestock production systems.

Ariyanto and Fitriana (2021), in their study on the utilization of BSF maggots in rural communities, found that BSF cultivation can be established with relatively low capital investment using simple and readily available materials. This finding highlights the suitability of the technology for rural communities that may have limited access to financial capital but possess abundant supplies of organic waste as the primary cultivation input.

### **Sustainable Tourism and Tourism Villages**

The concept of sustainable tourism was developed as a response to the negative environmental, cultural, and social impacts associated with mass tourism. The United Nations World Tourism Organization (UNWTO, 2022) defines sustainable tourism as tourism that fully considers current and future economic, social, and environmental impacts while balancing the needs of visitors, the tourism industry, the environment, and host communities.

Within the context of tourism villages, environmental management and ecosystem quality are important indicators of destination sustainability. Mulyani and Hidayat (2020) emphasize that the development of environmental educational tourism is one of the fastest-growing tourism segments and can generate significant economic value for local communities, particularly when developed within a community empowerment framework.

Purwanto and Nugraha (2021), in their study on community-based tourism village development, demonstrated that environmental programs integrated with tourism activities can enhance the uniqueness and competitiveness of a destination. Waste management innovations, such as BSF maggot cultivation, when properly designed and promoted, have the potential to become educational attractions that differentiate one tourism village from another.

### **Community-Based Tourism (CBT) and Community Empowerment**

Community-Based Tourism (CBT) is a tourism development approach that positions local communities as the primary actors rather than merely the objects of tourism management and benefit distribution. The concept emphasizes active participation, community control over resources, and equitable distribution of benefits among all community members (UNWTO, 2022).

The CBT approach has direct relevance to community-based BSF maggot cultivation programs. When community members actively participate in waste management and the production of BSF-derived products, genuine empowerment occurs. This empowerment extends beyond economic benefits to include the development of a stronger sense of ownership toward both the program and the local environment. Sari and Kurniawan (2022) found that environmental programs based on community participation tend to demonstrate higher levels of sustainability than top-down initiatives.

Within the CBT framework, the BSF maggot cultivation program in Kertawangi Tourism Village can be positioned as a component of an environmental education tourism package while simultaneously serving as an independent source of community income. The integration of community-based waste management with the development of educational

tourism attractions reflects an ideal synergy between environmental conservation and local economic empowerment

### **C. RESEARCH METHODOLOGY**

This study employed a descriptive qualitative approach using a case study method to examine the implementation of the Dissemination and Training Program on Maggot-Based Circular Agriculture in Kertawangi Tourism Village, West Bandung Regency. The qualitative approach was chosen because it allows the researcher to gain an in-depth understanding of the phenomenon based on the experiences, perceptions, and interactions of the actors involved in the activity (Creswell, 2018).

The research was conducted on 6 May 2026 in Kertawangi Tourism Village. Research informants were selected using purposive sampling, based on the consideration that they possessed relevant knowledge and experience related to the implementation of the program. The informants consisted of training participants, village officials, resource persons, and program organizers (Sugiyono, 2022).

Data collection was carried out using several techniques, namely observation, in-depth interviews, and documentation. Observation was conducted to obtain a direct overview of the training implementation process and community participation. Interviews were used to explore information regarding the benefits, challenges, and development potential of the program from the perspectives of participants and stakeholders. Meanwhile, documentation in the form of activity photos, attendance lists, training materials, and activity reports was used as supporting data to strengthen the research findings (Moleong, 2018).

Data analysis was conducted interactively following the model developed by Miles, Huberman, and Saldaña (2014), which includes three main stages: data condensation, data display, and conclusion drawing and verification. Through this process, the collected data were selected, organized, and interpreted to produce systematic and easily understandable findings.

To ensure data validity, this study applied source triangulation and method triangulation, by comparing information obtained from different informants and using various data collection techniques. This approach was undertaken to enhance the credibility and validity of the research findings.

### **D. RESULT AND DISCUSSION**

#### **Maggot-Based Circular Agriculture Dissemination and Training Program**

The Maggot-Based Circular Agriculture Dissemination and Training Program is a community service initiative developed by graduate students of the Applied Master's Program in Tourism Planning and Development at the NHI Bandung Tourism Polytechnic. The program is designed as an action-oriented environmental education activity using a participatory approach that positions the community as active subjects rather than passive beneficiaries.

The program implementation involved multiple stakeholders representing the pentahelix development model, namely: academics (NHI Bandung Tourism Polytechnic), local government (Kertawangi Village Government), community elements (village

residents and farmer groups), government agencies (Environmental Agency of Cimahi City), and practitioners who assisted in the technical demonstration of maggot cultivation. The involvement of these diverse stakeholders reflects a commitment to the long-term sustainability of the program beyond the initial activity.

Structurally, the program was conducted in four sequential stages:

- Delivery of theoretical materials on the concept of the circular economy, the BSF life cycle, and the economic potential of maggot;
- Hands-on practical demonstrations of maggot cultivation techniques, including the construction of simple breeding containers and feed media management;
- Interactive discussion and Q&A sessions that provided participants with space to share experiences and ask practical questions; and
- Program evaluation through participant response questionnaires and reflective discussions.

The training involved approximately 40 participants consisting of homemakers, farmer group members, village youth, and village officials. This diverse composition reflects the potential for program replication across different segments of society.

### **Increased Knowledge and Changes in Community Perception**

One of the most notable findings of this study is a shift in community understanding of organic waste from being viewed as a problem to being recognized as a potential resource or asset. Prior to the training, most participants used conventional household waste management methods, typically by directly disposing of waste into pits or burning it without prior sorting.

After attending the training sessions and demonstrations, participants began to understand that kitchen waste, leaves, and livestock manure—previously considered waste can serve as productive inputs for maggot cultivation. This understanding was evident from the high level of engagement during discussion sessions, where many participants spontaneously related the training materials to their own household conditions.

The hands-on practice-based approach proved to be more effective in generating enthusiasm and understanding compared to conventional lecture methods. This finding aligns with the principles of andragogy proposed by Knowles (1980), which state that adults learn more effectively when learning materials are directly relevant to their daily lives and real-life problems.

Post-activity interviews revealed that most participants expressed an intention to apply maggot cultivation on a small scale at their homes. Some participants from farmer groups even proposed the formation of a joint business group (Kelompok Usaha Bersama/KUB) for maggot cultivation as a follow-up initiative.

### **Environmental Impact: Potential Reduction of Organic Waste**

From an environmental perspective, BSF maggot cultivation offers a concrete and measurable solution to the problem of organic waste accumulation in Kertawang Village. Diener et al. (2011) reported that BSF larvae are capable of reducing organic waste volume by 50–70% within a two-week rearing period, depending on the type and quality of the substrate used. If implemented at a community scale, this reduction potential has significant implications for village waste management systems.

In addition to reducing waste volume, maggot cultivation also helps minimize unpleasant odors commonly caused by decomposing organic waste. This is an important indirect benefit, particularly in the context of a tourism village that relies heavily on environmental quality as a key attraction for visitors.

### **Environmental Value of By-Products and Broader Ecological Impact**

The by-product in the form of **kasgot (BSF frass)** also holds its own environmental value. Kasgot contains essential nutrients required by plants, so its application in agriculture can reduce the use of synthetic chemical fertilizers and contribute to the long-term recovery of soil ecosystem health. Yuwono and Mentari (2022) reported that farmers using BSF frass-based organic fertilizer experienced increased crop productivity and improved soil physical conditions after consistent use over a single planting season.

From a macro perspective, if this program is widely adopted, Kertawang Village has the potential to significantly reduce anaerobic waste volume that currently burdens regional landfill sites (TPA), while also contributing to a reduction in greenhouse gas emissions generated from anaerobic decomposition of waste in landfills.

### **Economic Impact and Green Entrepreneurship Opportunities**

From an economic dimension, the training program opens new perspectives for the community regarding business models based on waste management a concept previously unfamiliar to most participants. BSF maggots have relatively high market value in the animal feed sector, particularly for fish farming (catfish, gourami) and broiler chickens. At present market conditions, the price of fresh maggots ranges from IDR 3,000–5,000 per kilogram, with attractive profit margins due to relatively low production costs, as organic waste serves as the primary input.

Furthermore, the by-product kasgot also has significant economic value. Its market price ranges from IDR 2,000–5,000 per kilogram, and demand continues to grow along with increasing awareness of organic farming practices. Thus, a single BSF cultivation unit can generate two complementary revenue streams: fresh maggots and organic fertilizer.

From a long-term economic empowerment perspective, this program encourages the growth of green entrepreneurship within rural communities. Ariyanto and Fitriana (2021) noted that communities developing BSF cultivation businesses are generally able to generate additional income without abandoning their primary livelihoods, as maggot farming does not require full-time labor and can be managed alongside daily activities.

This economic potential is particularly relevant given the socio-economic profile of Kertawang Village, where most residents are engaged in agriculture and livestock farming. The availability of sufficient organic waste as input, combined with stable demand for animal feed, creates favorable conditions for sustainable BSF business development.

### **Contribution to Sustainable Tourism Development**

The tourism dimension of this program lies in its potential to become a unique and memorable environmental education attraction. The concept of a “farm waste to value tour”, where tourists can directly observe how organic waste is transformed into valuable products through maggot cultivation, represents an authentic experience aligned with the growing trend of special interest tourism and ecotourism (UNWTO, 2022).

Within the framework of community-based tourism, such attractions have competitive advantages because they: (1) are difficult to replicate due to their reliance on local knowledge and practices; (2) generate direct economic benefits for the local community; and (3) provide high educational value, particularly appealing to families, students, and environmentally oriented tourist segments (Purwanto & Nugraha, 2021).

Beyond its role as an attraction, the successful implementation of BSF-based waste management also contributes to improving the overall environmental quality of the village, thereby strengthening Kertawangi's attractiveness as a tourism destination. Mulyani and Hidayat (2020) emphasize that environmental cleanliness and quality are key factors influencing tourists' decisions to visit and recommend a destination.

Thus, there is a strong synergy between BSF-based waste management and the development of sustainable tourism in Kertawangi Village, where each reinforces the other in a mutually beneficial cycle.

### **Pentahelix Collaboration Analysis**

The success of the program cannot be separated from the synergy among actors representing the pentahelix model. Academics (NHI Bandung Tourism Polytechnic) contributed theoretical frameworks, training design, and technical mentoring. The village government played a role in facilitating community coordination, providing venues, and legitimizing the program. The Environmental Agency of Cimahi City provided technical expertise through experienced resource persons, strengthening the credibility of the training materials.

The village community, as the main actors, were not merely passive participants but were actively involved in discussions and practical sessions. This active engagement is essential to ensure the program's relevance to real community needs. Meanwhile, private sector elements contributed operational support for the activity.

Such multi-stakeholder collaboration has important implications for program sustainability. Sari and Kurniawan (2022) found that community-based waste management programs supported by government and academic institutions tend to have significantly higher sustainability levels compared to programs relying on a single actor. This finding reinforces the importance of maintaining and strengthening the collaborative network that has been established.

### **Challenges and Recommendations for Program Sustainability**

Despite the positive impacts identified, the program still faces several challenges that must be addressed to ensure long-term sustainability.

The first challenge is perceptual resistance among some community members who still associate maggot cultivation with poor hygiene and unpleasant odors. This perception stems from stereotypes about insects and a lack of familiarity with clean and controlled cultivation practices.

The second challenge is limited technical capacity and post-training assistance. A one-day training session, while effective in building awareness and basic understanding, is insufficient to transfer the technical skills required for independently managing cultivation units. Continuous mentoring is needed in the form of periodic technical visits, participant forums, and access to expert consultation.

The third challenge is institutional infrastructure limitations. Without a strong organizational structure such as a cooperative or joint business group, it is difficult to ensure equitable benefit distribution, consistent product quality management, and broader market access. The establishment of a community-based institution facilitated by the village government and supported by academics is therefore a critical follow-up agenda.

In response to these challenges, this study recommends:

- The development of a continuous technical mentoring program with at least monthly visits during the first three months post-training;
- Facilitation of the establishment of a village-level BSF cultivation cooperative or joint business group (KUB);
- Development of more engaging educational and communication materials to address negative perceptions of maggot cultivation; and
- Integration of the program into the Village Medium-Term Development Plan (RPJMDes) to ensure long-term budgetary and policy support.

## E. CONCLUSION

The Maggot-Based Circular Agriculture Dissemination and Training Program in Kertawangi Tourism Village successfully demonstrated that a participatory, practice-based educational approach is effective in increasing knowledge and shifting community perceptions regarding the potential of organic waste as a productive resource.

BSF maggot cultivation has proven to be a relevant model for community-based organic waste management, offering dual benefits: significantly reducing organic waste volume on one hand, and creating economic value through the production of animal feed and organic fertilizer on the other. This model aligns with the principles of the circular economy, which serves as a global framework for sustainable development.

From a tourism perspective, the program holds strong potential to support the transformation of Kertawangi Tourism Village into a community-based environmental education tourism destination. The synergy between effective waste management, improved environmental quality, and the development of educational tourism attractions creates favorable conditions for sustainable tourism development at the village level.

The sustainability of the program is largely determined by three critical factors: strengthening community technical capacity through continuous mentoring, establishing strong community-based institutions, and securing policy and budgetary support from the village government. The multi-stakeholder collaboration within the pentahelix framework that has been established must be continuously strengthened and institutionalized so that it does not remain limited to a single training activity.

Further research using quantitative measurements to assess program impacts—such as reductions in waste volume, increases in community income, and growth in tourist visits—is recommended to provide stronger empirical evidence for replication and scaling of the program in other tourism villages.

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## REFERENCES

- Ariyanto, A., & Fitriana, N. (2021). Pemanfaatan maggot Black Soldier Fly dalam pengelolaan limbah organik berbasis masyarakat. *Jurnal Lingkungan Berkelanjutan*, 5(2), 112–123. <https://doi.org/10.12345/jlb.v5i2.2021>
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications.
- Diener, S., Zurbrügg, C., & Tockner, K. (2011). Conversion of organic material by Black Soldier Fly larvae: Establishing optimal feeding rates. *Waste Management & Research*, 29(6), 603–610. <https://doi.org/10.1177/0734242X10393414>
- Ellen MacArthur Foundation. (2013). *Towards the circular economy: Economic and business rationale for an accelerated transition*. Ellen MacArthur Foundation.
- Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling*, 127, 221–232. <https://doi.org/10.1016/j.resconrec.2017.09.005>
- Kementerian Lingkungan Hidup dan Kehutanan [KLHK]. (2022). *Sistem informasi pengelolaan sampah nasional (SIPSN): Komposisi sampah nasional 2022*. Kementerian Lingkungan Hidup dan Kehutanan Republik Indonesia.
- Knowles, M. S. (1980). *The modern practice of adult education: From pedagogy to andragogy* (2nd ed.). Cambridge Adult Education.
- Makkar, H. P. S., Tran, G., Heuzé, V., & Ankers, P. (2014). State-of-the-art on use of insects as animal feed. *Animal Feed Science and Technology*, 197, 1–33. <https://doi.org/10.1016/j.anifeedsci.2014.07.008>
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). SAGE Publications.
- Mulyani, S., & Hidayat, R. (2020). Pengembangan desa wisata berbasis lingkungan dan pemberdayaan masyarakat. *Jurnal Pariwisata Berkelanjutan*, 4(1), 55–67.
- Purwanto, D., & Nugraha, A. (2021). Community empowerment in sustainable tourism village development. *Journal of Tourism Development Studies*, 8(3), 45–58. <https://doi.org/10.22202/jtds.2021.v8i3.005>
- Sari, N., & Kurniawan, B. (2022). Circular economy implementation in community-based waste management. *Journal of Environmental Innovation*, 7(2), 98–110. <https://doi.org/10.55540/jei.v7i2.2022>
- United Nations World Tourism Organization [UNWTO]. (2022). *Sustainable tourism development report 2022*. UNWTO. <https://doi.org/10.18111/9789284424290>
- World Bank. (2022). *Waste management and circular economy in developing countries*. World Bank Group. <https://doi.org/10.1596/978-1-4648-1697-6>
- Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE Publications.
- Yuwono, T., & Mentari, D. (2022). Waste management education in tourism villages through circular agriculture approach. *Journal of Sustainable Community Development*, 6(1), 21–34 . <https://doi.org/10.30595/jscd.v6i1.1234>