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STRENGTHENING MAGI FARM'S BUSINESS CAPACITY THROUGH OPERATIONAL STANDARDIZATION AND DIGITAL MARKETING IN BSF-BASED FOOD WASTE BIOCONVERSION

Putu Ayu Sita Laksmi[1*], Komang Adi Kurniawan Saputra[1], I Gde Wedana Arjawa[1], Putu Aryastana[1], I Made Satria Darmayoga[1], Gusti Ngurah Danan Agastira[1], Gina B. Alcoriza[2]

[1] Universitas Warmadewa, Denpasar, Bali, Indonesia

[2] University of the Philippines, Philippines

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***Corresponding author:** Putu Ayu Sita Laksmi

Abstract

The increasing volume of food waste has become a significant environmental challenge in Bali, driven by the growth of tourism, households, restaurants, and hotels. Magi Farm, a startup business in Bali, has implemented Black Soldier Fly (BSF) bioconversion technology to process food waste into valuable products such as high-protein animal feed and organic fertilizer (frass). However, operational constraints including the absence of Standard Operating Procedures (SOP), suboptimal temperature and humidity control, limited production facilities, and underdeveloped digital marketing have hindered optimal business capacity. This community service program aimed to strengthen Magi Farm's capacity through operational standardization and digital marketing development. The program employed participatory methods including socialization and needs identification, production and operational management training, digital marketing and branding training, technology and SOP implementation, mentoring and monitoring, and program sustainability evaluation. Technologies and innovations implemented included SOP development for BSF bioconversion, temperature and humidity monitoring tools, additional production trays and racks, digital production recording using Google Sheets, and marketing materials including photos, videos, posters, infographics, and educational narratives. Branding was strengthened to position Magi Farm as a circular economy-based enterprise. Results demonstrated increased partner understanding and capacity in structured food waste bioconversion management, standardized production processes, environmental condition control, data-based production recording, and digital marketing development. Activities were conducted participatively through material delivery, experience sharing, discussions, and technology implementation mentoring. This program contributes to food waste reduction, circular economy implementation, and the development of replicable models for organic waste management in Bali.

Keywords: Black Soldier Fly, bioconversion, circular economy, community empowerment, digital marketing, food waste, operational standardization.

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1. INTRODUCTION

1.1 Background

The escalating volume of food waste has emerged as one of the most pressing environmental challenges in Bali in recent years. The growth of the tourism sector, along with household, restaurant, and hotel activities, significantly contributes to organic waste generation on a daily basis. Most of this waste still ends up in landfills with increasingly limited capacity (Cucchiella et al., 2014). This condition not only creates aesthetic and environmental health problems but also contributes to increased methane gas emissions that impact climate change. On the other hand, awareness and practice of waste sorting at the source remain suboptimal, so organic waste that could potentially be processed has not been maximally utilized (Saputra, 2021).

The magnitude of this challenge demands an approach that not only addresses waste as an environmental burden but also transforms it into economic opportunities. In the context of sustainable waste management, the circular economy approach has been increasingly introduced as a solution oriented not only toward waste reduction but also toward creating economic value from waste (Schindler & Demaria, 2020). This approach aims to keep resources in use for as long as possible, extract the maximum value from them while in use, and recover and regenerate products and materials at the end of each service life.

One technology that has developed rapidly within this circular economy framework is bioconversion of organic waste using Black Soldier Fly (BSF) larvae. BSF larvae have the ability to decompose food waste quickly and efficiently, while simultaneously producing valuable products such as high-protein animal feed and organic fertilizer (frass). This technology is considered simple, environmentally friendly, and highly suitable for application at small and medium enterprise scales at the community level. The BSF bioconversion process offers a solution that addresses multiple challenges simultaneously: waste reduction, protein production for animal feed, and organic fertilizer generation (Yanakittkul & Aungvaravong, 2019).

1.2 The Magi Farm Initiative

Magi Farm represents a pioneering startup business in Bali that has implemented BSF bioconversion technology to manage food waste from households, restaurants, and hotels. The existence of Magi Farm demonstrates that organic waste management can be developed into a productive business that provides both environmental impact and economic value. This potential positions Magi Farm not only as a business entity but also as a tangible example of a community-based waste management model that can be replicated (Xue & Shen, 2022; Yun et al., 2025).

The business model of Magi Farm involves collecting food waste from various sources, processing it through BSF bioconversion, and producing marketable products including BSF larvae for animal feed and frass for organic fertilizer. This model aligns with the principles of circular economy by transforming waste into valuable resources, creating economic opportunities, and reducing environmental burden.

However, despite having significant potential, Magi Farm's operational practices still face several constraints that hinder optimization of business capacity and environmental impact. Based on agreements with the target partners, the priority problems faced by Magi Farm can be grouped into two main aspects: production and operational management aspects, and digital-based business marketing aspects (Abad-Grillo & McNaughton-Smith, 2024). These challenges limit the business's ability to scale operations, achieve consistent results, and effectively communicate its value proposition to potential customers.

1.3 Problem Identification

In the production and operational management aspect, the process of waste reception, raw material sorting, feeding, larval maintenance, and harvesting is still carried out without standardized Standard Operating Procedures (SOP). Temperature, humidity, and feed media quality have not been optimally controlled, affecting harvest success rates. Furthermore, the absence of a standardized production recording system means data on incoming waste volume, conversion rates, and harvest results are not well documented (Taufiqqurrachman et al., 2024). This condition makes production evaluation and business growth projection difficult to measure accurately.

The absence of SOP leads to inconsistent work processes among workers, with production outcomes heavily dependent on individual experience rather than standardized systems. This variability affects product quality and business reliability (Chen et al., 2025). Additionally, environmental monitoring has been conducted informally, without systematic measurement and recording of critical parameters that influence larval growth and development.

In the digital-based business marketing aspect, promotion of BSF larvae and frass products is still conducted simply and has not optimally utilized digital media. The circular economy-based business branding has not been effectively communicated to consumers. The lack of educational content, activity documentation, and publication materials means Magi Farm's potential as a sustainable waste management model is not widely known by the public or potential markets (El-Kassar et al., 2022). This limited visibility constrains market expansion and the business's ability to attract customers who value sustainability and environmental responsibility.

1.4 Program Significance

This activity aligns with the implementation of Merdeka Belajar Kampus Merdeka (MBKM), which encourages students to be directly involved in environmental-based business empowerment processes through learning experiences in the field. Student involvement in observation, operational mentoring, production data recording, and digital marketing content creation provides contextual learning opportunities relevant to the real world. This program simultaneously supports the achievement of Higher Education Key Performance Indicators, particularly in the aspects of lecturer-student collaboration in community service activities and the strengthening of strategic partnerships with business actors.

On the other hand, this program also strengthens the role of higher education institutions in supporting the green economy agenda and sustainable environmental management through strengthening local business capacity. By building more standardized operational systems and more adaptive digital-based marketing, Magi Farm is directed to become an efficient, independent, and sustainable organic waste management business model. Therefore, the success of this program is measured not only from the improvement of partner business performance but also from its contribution to

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reducing food waste and encouraging the creation of circular economy practices that can be replicated in Bali.

2. LITERATURE REVIEW

2.1 Black Soldier Fly Bioconversion Technology

Black Soldier Fly (Hermetia illucens) bioconversion has emerged as a promising technology for organic waste management. BSF larvae possess remarkable capabilities in converting organic waste into high-value biomass (Ewadh & Hussain, 2020). The larvae can consume up to 2-5 times their body weight daily, converting organic matter into protein-rich larval biomass and nutrient-dense frass (residual material). This process occurs rapidly, with complete bioconversion typically achieved within 14-21 days depending on environmental conditions (Baskar et al., 2022).

The technology offers multiple environmental and economic benefits. First, it significantly reduces organic waste volume, with studies showing waste reduction rates of 60-80%. Second, it produces valuable outputs including protein-rich larvae suitable for animal feed and frass that serves as excellent organic fertilizer (Kabir et al., 2020). Third, the process generates significantly lower greenhouse gas emissions compared to conventional waste disposal methods such as landfilling.

2.2 Operational Standardization in Small Enterprises

Standard Operating Procedures (SOP) represent a critical element for business development and quality consistency. For small enterprises such as Magi Farm, SOP implementation provides several benefits including work process standardization, quality consistency, easier training and worker orientation, improved efficiency, and better accountability (Anggreni et al., 2023). SOP development should be tailored to business scale and capacity, prioritizing simplicity and practicality while ensuring comprehensive coverage of critical processes.

Key components of SOP for BSF bioconversion operations include waste reception and sorting procedures, feeding protocols, environmental condition monitoring, larval maintenance procedures, harvesting processes, frass collection and management, and recording and documentation requirements (Saputra, Laksmi, et al., 2025). Each component should specify procedures, responsible personnel, frequency, and documentation requirements.

2.3 Digital Marketing for Small Businesses

Digital marketing has become increasingly important for small business growth, offering cost-effective channels for reaching wider audiences. For sustainability-oriented businesses like Magi Farm, digital marketing enables communication of environmental and social value propositions alongside product benefits (Sara & Saputra, 2021).

Effective digital marketing strategies for small businesses include content marketing through engaging visual and written content, social media presence and engagement, storytelling that communicates business values and impact, customer education about products and processes, and consistent branding across all digital platforms.

2.4 Circular Economy and Food Waste Management

The circular economy model presents a paradigm shift from traditional linear economic models. Instead of "take-make-dispose" approaches, circular economy emphasizes keeping resources in use, extracting maximum value, and recovering and regenerating products and materials. Food waste management represents a critical application area for circular economy principles (Saputra, Jayawarsa, et al., 2025).

BSF bioconversion aligns strongly with circular economy principles by transforming food waste (a resource that would otherwise be lost) into valuable products that support other economic activities such as agriculture and animal production (Saputra & Jayawarsa, 2023). This creates closed-loop systems where waste becomes a resource, reducing environmental impact while generating economic value.

3. METHODOLOGY

3.1 Program Design

The community service program employed a systematic, participatory methodology designed to empower partners through sustainable capacity building. The approach encompassed five integrated stages: socialization and needs identification, production and operational management training, digital marketing and branding training, technology and SOP implementation, and mentoring and monitoring (Sara et al., 2021). This comprehensive approach ensured that solutions provided were not merely theoretical but were practically applied and integrated into Magi Farm's daily operations.

3.2 Stage 1: Socialization and Partner Needs Identification

The program commenced with program socialization to the partner and in-depth discussions to map the real operational conditions of Magi Farm. At this stage, observations were conducted on production flow, worker practices, existing recording systems, and marketing patterns (NHS England & NHS Improvement, 2020). The identification results served as the foundation for developing SOP, digital recording systems, and training materials tailored to partner needs. This stage ensured that all subsequent interventions were based on actual partner conditions rather than assumptions.

3.3 Stage 2: Production and Operational Management Training

Training focused on developing and understanding SOP for BSF bioconversion production. Partners were provided with understanding of standardized work processes from waste reception to harvesting. Additionally, partners were trained in the use of temperature and humidity measuring instruments to maintain ideal conditions for larval growth (Sara & Saputra, 2021). This stage also included training in using Google Sheets as a daily production recording system, covering data entry on incoming waste volume, larval development, harvest results, and production environmental conditions.

3.4 Stage 3: Digital Marketing and Branding Training

Partners received training in photo, video, and educational narrative-based marketing content creation. The team assisted partners in creating publication materials including posters, infographics, and social media content highlighting the bioconversion process and business environmental impact (Julier, 2020; Peresada et al., 2022). This stage also included mentoring in circular economy-based business identity development and pricing scheme preparation based on production data.

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3.5 Stage 4: Technology and SOP Implementation

Following training, direct SOP implementation was conducted at the production location. Additional trays and racks began to be utilized, temperature and humidity measuring instruments were installed, and the digital recording system commenced daily application. The team provided intensive mentoring to ensure partners consistently implemented SOP and the recording system .

3.6 Stage 5: Mentoring and Monitoring

Regular mentoring was conducted to evaluate SOP implementation, recording consistency, and digital marketing activities. Monitoring was performed by reviewing Google Sheets data, production results, and partner social media content development. This stage aimed to ensure that changes were maintained beyond the training period and became Magi Farm's new work system.

3.7 Stage 6: Evaluation and Program Sustainability

Evaluation was conducted by comparing pre-program and post-program conditions, covering increased waste processing capacity, harvest consistency, production recording accuracy, and increased digital marketing activity. At the program's conclusion, all SOP documents, recording templates, and marketing materials were handed over to partners for independent use.

4. RESULTS AND DISCUSSION

4.1 Implementation Activities

The community service activities at Magi Farm were conducted interactively through a series of activities including material delivery, experience sharing with partners, discussions, and participant appreciation. Each activity was directed to improve partner understanding and capacity in developing BSF-based food waste management responsibly, sustainably, and with economic value.

4.1.1Material Delivery by the Team

Activities commenced with material delivery by the lead researcher to participants at Magi Farm. The material covered responsible and sustainable food waste management and its relationship with Magi Farm business development. The presentation utilized media displaying Magi Farm's profile and journey in managing food waste. Participants followed the presentation enthusiastically and gained understanding of the importance of integrating environmental aspects, business management, and technology utilization in building sustainable businesses (Anis et al., 2023; Hall, 2019). Through this session, participants gained not only conceptual understanding of food waste management but were also invited to see that food waste can be converted into valuable resources through BSF utilization (Rasoolimanesh et al., 2020; Velenturf & Purnell, 2021). The material also emphasized the importance of more systematic management so that Magi Farm's activities could develop into a business model with stronger operational processes and economic value.

4.1.2Experience Sharing by Magi Farm Partners

Following material delivery, activities continued with experience sharing by Magi Farm partners. In this session, Magi Farm directly shared experiences regarding business activities and food waste management processes undertaken. Participants gained a more realistic picture of how food waste is collected and utilized through the BSF bioconversion process to produce beneficial and economically valuable products (Mohd Noh et al., 2020).

This sharing session became an important part of the activity because participants could directly observe management practices in the field. Discussions occurred in an open atmosphere, with participants listening to explanations and discussing experiences, work processes, and challenges faced in Magi Farm development (Laksmi et al., 2023). Through partner presentations, conceptual knowledge was directly linked to real business conditions.

4.1.3Discussion and Interaction with Participants

Following presentations from the team and partners, the activity continued with discussion sessions. Participants sat together and listened to explanations regarding Magi Farm management and circular economy-based business development opportunities. The discussion atmosphere was relaxed but serious, reflected in participant attention during presentations and interactions throughout the activity (Laksmi & Arjawa, 2023).

These discussions became a space to bring together academic knowledge and practical partner experience. Participants had opportunities to understand food waste management, BSF bioconversion processes, and the importance of building businesses oriented not only toward profit but also toward environmental benefits (Saputra, Jayawarsa, et al., 2025). This interaction simultaneously strengthened the knowledge transfer process between the team, partners, and participants.

4.1.4Certificate Presentation

As part of the concluding activity, certificate presentation was conducted to participants. Certificate presentation became a form of appreciation for attendance, participation, and involvement during community service activities at Magi Farm. The certificate presentation moment occurred in a warm and collaborative atmosphere, symbolizing appreciation for the contributions of all parties supporting activity implementation.

Certificate presentation also marked the successful completion of the activity series. Following activity completion, the team and participants conducted collaborative documentation at Magi Farm. This togetherness illustrated the collaborative relationship built between higher education institutions and partners in encouraging business development that prioritizes sustainability, innovation, and food waste utilization as valuable resources.

4.1.5Collaborative Documentation

The activity series concluded with collaborative documentation of all teams and participants in front of Magi Farm. This group photo became an important part of implementation documentation as it showed the involvement of various parties in community service activities. All participants appeared standing together in an enthusiastic atmosphere after following the complete activity series.

This documentation simultaneously represented the spirit of collaboration underlying program implementation. Community service activities produced not only knowledge transfer processes but also strengthened relationships between academic teams and partners in developing Magi Farm as a business combining food waste management, BSF bioconversion, economic value, and environmental sustainability.

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4.2 Technology and Innovation Products

Technology and innovation products implemented in the community service activities at Magi Farm were designed to address partner needs in production, operational management, and business marketing aspects. Products provided included not only physical devices (hard technology) but also systems, knowledge, skills, and managerial tools (soft technology) that partners could use sustainably.

4.2.1Hard Technology Products

In the hard technology aspect, the program provided additional cultivation trays and production racks to optimize space utilization and increase food waste processing capacity. Production facility arrangement was also directed toward creating more efficient work flows. Additionally, partners were introduced to and mentored in using temperature and humidity measuring instruments to help monitor environmental conditions affecting BSF larval growth. These facility applications became part of efforts to transform production processes from predominantly experience-based to more measured processes.

4.2.2Soft Technology Products

In the soft technology aspect, the main innovation product provided was the BSF bioconversion production SOP, covering waste reception and sorting stages, feeding, larval maintenance, harvesting, and frass separation processes. This SOP became a work guideline for partners so production processes could be conducted more consistently and standardly (Chowdhury et al., 2023; Napierała et al., 2020).

Another innovation was the digital production recording system using Google Sheets. This system was designed to record incoming waste volume, larval development, harvest results, frass production, and temperature and humidity conditions (Gokoglan et al., 2022). With this system, Magi Farm began to develop more organized, measurable production data easily used for evaluation and business decision-making (Smithers & Blay-Palmer, 2001).

In the marketing field, innovation products implemented included digital marketing materials, posters, infographics, photo and video content, and educational narratives highlighting Magi Farm's bioconversion process and positive environmental impact. The program also provided circular economy-based branding strengthening so Magi Farm's identity was positioned not only as a waste processing business but as a business creating economic value while providing environmental benefits.

4.3 Technology and Innovation Implementation

Technology and innovation implementation with the Magi Farm partner was conducted through participatory and direct mentoring approaches, ensuring technology provided did not stop at socialization or training stages but could be applied in daily business activities. Activity stages began with observation and identification of partner conditions, then continued with training, implementation, mentoring, monitoring, and evaluation (Laksmi et al., 2024). This approach allowed solutions provided to be truly tailored to Magi Farm's needs and capacity.

Technology relevance was evident from its alignment with main partner problems. Before the program, waste reception, raw material sorting, feeding, larval maintenance, and harvesting processes had no standard SOP. Temperature and humidity control was also not optimally managed, while waste volume recording, conversion rates, and harvest results were not systematically documented. In marketing, promotion remained simple, and Magi Farm's identity as a circular economy-based business was not optimally communicated (Saputra et al., 2021).

To address these conditions, partners directly participated in understanding and applying production SOP, using temperature and humidity measuring instruments, and conducting production recording through Google Sheets. Partners were also involved in marketing content creation, publication material preparation, storytelling strengthening, and circular economy-based business identity development. Thus, partners were not positioned as passive technology recipients but as main actors using, adapting, and continuing technology in business activities (Jayawarsa et al., 2021).

Partner participation was also visible in the implementation process at production locations. Additional trays and racks began to be used to support capacity and space efficiency improvement, while temperature and humidity instruments were used to support production condition control. The digital recording system began to be applied in daily activities and became monitoring material for the team (Pamuk et al., 2014).

In marketing, partner participation was realized through involvement in creating and developing content showcasing Magi Farm activities. This approach was relevant because the business's main strength lay not only in BSF larvae and frass products but also in the sustainability story behind these products—how food waste could be converted into economically valuable products. Photo, video, poster, infographic, and educational narrative materials became means to communicate this value to the public and potential customers (Liu et al., 2023).

Active participant involvement in material sessions, discussions, experience sharing from Magi Farm, documentation, and certificate presentation demonstrated that innovation implementation occurred in a collaborative atmosphere. Through these interactions, academic knowledge brought by the team was brought together with partner practical experience, producing two-way learning (Sun et al., 2022).

Implementation sustainability also became an important part of technology delivery. After training and implementation activities, the team monitored SOP implementation, recording consistency, production results, and digital marketing activities. SOP documents, recording templates, and marketing materials were handed over to partners for continued independent use after program completion.

4.4 Impact and Benefits

The technology and innovation implementation impacted changes in how Magi Farm managed business activities. The main impact was seen in the beginning formation of more structured, standardized, and data-based work systems. Through SOP implementation, each bioconversion process stage had clearer guidelines, while temperature and humidity instruments helped partners monitor production environmental conditions. Additional trays and racks also supported space optimization and increased waste processing capacity.

From the management side, Google Sheets usage provided important changes as production data began to be systematically recorded and documented. Data on incoming waste volume, larval development, harvest results, frass production, and environmental

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conditions could be used as evaluation material. This change encouraged Magi Farm toward more data-driven business management patterns, so production and business development decisions were no longer based solely on estimates.

Further impact emerged in marketing and business identity aspects. Through training and digital marketing mentoring, Magi Farm began to develop stronger communication approaches to introduce products while communicating sustainability value central to its business character. Photo, video, poster, infographic, and educational narrative content enabled food waste bioconversion processes to be communicated more attractively to the public.

The program also provided benefits in strengthening Magi Farm's position as a circular economy-based business. Food waste previously viewed as an environmental problem was positioned as raw material convertible into valuable products, particularly BSF larvae and frass. With this approach, business activities had dual benefits: helping reduce organic waste problems and creating economic opportunities for partners.

From a productivity perspective, technology implementation supported increased waste processing capacity, harvest consistency, space efficiency, and partner capacity for production evaluation. The program measured changes through indicators including waste processing capacity, harvest consistency, production recording accuracy, and increased digital marketing activity.

Furthermore, program impact was not only felt at Magi Farm's internal level. The applied model has potential to be developed as an example of innovative and sustainable community empowerment based on organic waste management. The integration of BSF bioconversion, operational standardization, digital recording, and circular economy-based marketing provided Magi Farm with a foundation to develop as a business model replicable by other business actors and communities facing similar food waste management problems.

Overall, program impact could be summarized as transformation from simple, undocumented management toward more standardized, measurable, digitized, and market-oriented systems. Technology implemented did not only produce devices or documents but built new partner capabilities in production management, data reading, marketing development, and communicating business sustainability value. Thus, technology and innovation delivery provided integrated benefits encompassing economic benefit, productivity improvement, partner capacity strengthening, and environmental sustainability.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The implementation of the community service program at Magi Farm has strengthened partner capacity in developing BSF-based food waste bioconversion businesses. Activities provided not only conceptual understanding but also introduced and applied technology and innovations relevant to partner needs, including production process standardization, production facility strengthening, environmental condition measurement, digital production recording, and circular economy-based marketing and branding development.

SOP implementation provided a foundation for partners to conduct production processes more structurally and consistently. Digital recording system use provided a foundation for data-based business management, while production facility strengthening and instrument use supported more controlled production processes. In marketing, content and sustainability narrative development strengthened Magi Farm's identity as a business producing not only products but also contributing to food waste reduction.

Overall, activities have built a foundation for Magi Farm's transformation toward a more standardized, measurable, digitized, productive, and sustainability-oriented business. Program success depends heavily on partner consistency in applying provided technology and systems and continued mentoring and evaluation.

5.2 Recommendations

Program sustainability should be directed toward consistent SOP and digital recording implementation in Magi Farm operational activities. Partners are advised to use production data as a basis for evaluation and business decision-making so productivity development can be monitored regularly.

Magi Farm also needs to maintain consistent digital marketing activities by developing content that not only showcases products but also highlights the story, process, and environmental impact of BSF-based food waste management. This approach can become Magi Farm's differentiator amid the growing sustainability-based business landscape.

Furthermore, team mentoring needs to continue gradually to ensure provided technology and innovations are truly used independently by partners. Regular evaluation of waste processing capacity, production results, business recording, and marketing development is needed so the program can provide long-term impact and open development opportunities for Magi Farm as a circular economy-based food waste management model replicable in communities.

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