International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/

Vol. 56 No. 2 April 2026, pp. 944-959

Analysis Of Digital Business Models In Strengthening Maggot-Based Biopreneurship And Its Derivative Products At Bsu Siliwangi

Ade Yusdira, Yulia Nurendah, Ervina Indrisari, Mumuh Mulyana, Sulistiono, Resa Sukmawati, Alvira Nur Dzikriyah

Institut Bisnis dan Informatika Kesatuan
Bogor, Indonesia
Corresponding Author: Ade Yusdira. E-mail: adeyusdira@ibik.ac.id

Abstract— Maggot based biopreneurship using Black Soldier Fly (BSF) has strategic potential in supporting organic waste management, feed security, and the development of a circular economy. However, the sustainability of maggot enterprises, particularly at the community and environmentally based business unit levels, continues to face challenges related to limited market access, operational efficiency, and suboptimal utilization of digital technologies. This study aims to analyze the digital business model in strengthening maggot biopreneurship and its derivative products at the Siliwangi Waste Bank Unit (BSU) in Bogor. Specifically, the study examines the existing business model, assesses the role of digital marketing, financial recording, and e-commerce in business performance, evaluates the impact of the Kedaireka 2023 and Inovokasi 2024 grant programs, and formulates strategies for sustainable business model development.This research employs a descriptive-explanatory case study approach using mixed methods. Data were collected through document analysis, Business Model Canvas (BMC) mapping, digital capability assessment, as well as interviews and focus group discussions with the management of BSU Siliwangi. Data analysis focused on the nine BMC elements and the contribution of digitalization to value creation, operational efficiency, and business sustainability. The results indicate that the implementation of a digital business model positively contributes to strengthening maggot biopreneurship at BSU Siliwangi, particularly through expanded marketing reach, improved financial recording, and the utilization of e-commerce. The grant programs received have proven effective in enhancing operational capacity and business competitiveness. This study recommends the development of an integrated digital business model strategy to improve sustainability, value creation, and the social and environmental impacts of maggot-based biopreneurship

Keywords—digital business models, maggot, biopreneurship

I. INTRODUCTION

1.1. BACKGROUND

Entrepreneurship based on the utilization of biological resources, commonly referred to as biopreneurship, has gained increasing urgency in response to global concerns related to feed security, organic waste management, and the development of a circular economy. Biopreneurship emphasizes the creation of economic value in alignment with ecological and social sustainability principles through the optimization of biological resources (Halloran et al., 2018). Within this framework, the cultivation of Black Soldier Fly (BSF) larvae, commonly known as maggots, has emerged as an innovative and sustainable solution. BSF larvae possess a high bioconversion capacity, enabling the transformation of organic waste into economically valuable products, such as high-protein biomass for animal feed, as well as various derivative products, including organic fertilizer, liquid fertilizer, and frass (van Huis et al., 2018).

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 56 No. 2 April 2026, pp. 944-959

In Indonesia, the development of maggot-based enterprises has shown a significant upward trend over the past five years. This growth has been driven by the increasing demand for alternative protein sources in the animal feed industry and the growing public awareness of sustainable organic waste management. The application of BSF larvae-based bioconversion technology enables the transformation of organic waste into economically valuable biomass, in the form of fresh maggots, dried maggots, or processed feed ingredients. Meanwhile, the residual by-products of the bioconversion process can be further utilized as organic fertilizers (Nugroho et al., 2023). This condition has the potential to establish and expand new value chains involving various actors, ranging from farmers and waste managers to micro, small, and medium enterprises (MSMEs) engaged in the processing of maggot-derived products.

From a commercial perspective, the maggot business ecosystem exhibits differentiation based on the scale of operations. At the community and microenterprise levels, maggot production is generally oriented toward meeting local demand for alternative feed, particularly among small-scale livestock farmers. In contrast, at the medium to large enterprise scale, startups and companies adopting global and capital-intensive industrial business models have begun to emerge. Their outputs are not limited to dried maggots as feed ingredients but also include higher value-added derivative products, such as larval oil and organic fertilizers, thereby creating broader opportunities for market diversification The market prospects for maggot-based biopreneurship in Indonesia continue to strengthen amid rising prices of conventional feed ingredients, such as fish meal and soybean meal, as well as increasing interest from the aquaculture industry in sustainable and environmentally friendly alternative protein sources. Furthermore, the growing emphasis on sustainability and the circular economy has encouraged the utilization of BSF larvae as protein substitutes that are not solely profit-oriented but also aimed at generating positive environmental impacts. Nevertheless, the development of maggot-based biopreneurship remains constrained by several structural challenges, including the need for product quality standardization, regulatory certainty and harmonization related to food and feed safety, limited access to financing, and logistical constraints in the collection and management of organic waste as larval feed (Barragán-Fonseca et al., 2024). In this context, the analysis of digital business models becomes crucial for strengthening maggot-based biopreneurship, particularly amid digital transformation and the increasing demand for sustainable biological resource management solutions. The implementation of digital business models enables more effective value chain integration, market expansion, brand strengthening, and improved efficiency in distribution and resource management. Moreover, the adoption of digital technologies has the potential to address persistent challenges, such as limited access to information, low price transparency, and weak connectivity among producers, consumers, and other stakeholders within the maggot biopreneurship ecosystem.

Maggot-based biopreneurship, particularly that utilizing Black Soldier Fly (BSF) larvae, is highly relevant to several global strategic issues, including feed security, organic waste management, and the strengthening of the circular economy. BSF larvae demonstrate effective bioconversion capabilities in processing organic waste into high-protein biomass suitable for animal feed, while simultaneously generating various value-added by-products, such as organic fertilizers, liquid fertilizers, and frass. Therefore, the development of maggot-based biopreneurship contributes not only to addressing environmental challenges but also to creating new, inclusive, and sustainable economic opportunities (Halloran et al., 2018).

Within this development framework, the business model plays a strategic role as both an operational and conceptual system through which enterprises create and capture economic value. Wardhani (2020) emphasizes that business actors are required to select and design business models that are aligned with economic conditions, market potential, and internal organizational factors that influence adaptive capacity in response to changes in the business environment. This perspective is consistent with Gadang (2020), who positions the business model not merely as an operational pattern but as an adaptive strategic instrument in navigating business dynamics and uncertainty.

As digital transformation continues to evolve, business model dynamics have become increasingly complex, particularly for micro, small, and medium enterprises (MSMEs) and community-based business groups. Business digitalization offers opportunities to optimize value propositions, marketing channels, customer relationships, and revenue streams through the utilization of various digital technologies, including e-commerce, social commerce, digital analytics, and financial technology services. These dimensions can be comprehensively mapped using the Business Model Canvas (BMC) framework. Kotler, Kartajaya, and Setiawan (2021) assert that the BMC is a critical strategic tool for systematically and integratively visualizing the core elements of digital businesses.

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 56 No. 2 April 2026, pp. 944-959

Osterwalder and Pigneur (2010) describe the Business Model Canvas (BMC) as a conceptual tool that assists business actors in understanding their enterprises holistically—both at the macro level and in operational detail—through nine key elements: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure. A systematic assessment of each element enables enterprises or business groups to identify weaknesses, adjust strategies, and formulate more appropriate actions to achieve business objectives. Royan (2014) further notes that the BMC has been widely adopted across various business mapping contexts due to its practical and effective nature as a framework for enhancing business performance.

In the context of BSU Siliwangi, which is engaged in the development of maggot production and its derivative products, the analysis of digital business models using the BMC approach is highly relevant for strengthening competitiveness and business sustainability. Through structured mapping, BSU Siliwangi has the opportunity to identify superior value propositions, expand and strengthen market access through digital channels, build sustainable customer relationships, and optimize internal resource management and strategic partnerships. Accordingly, this study focuses on analyzing the extent to which the implementation of digital business models can contribute to enhancing competitiveness, expanding market reach, and strengthening the sustainability of maggot-based biopreneurship at BSU Siliwangi.

As a producer of maggots and their derivative products, BSU Siliwangi has received institutional support through the Kedaireka Grant Program in 2023 and the Inovokasi Grant Program in 2024, particularly in the areas of marketing, financial recording, equipment provision, as well as training and mentoring. This support serves as a strategic momentum to: (1) map the existing business model, (2) evaluate the role of digital technologies in value creation, delivery, and capture processes, and (3) formulate a measurable and sustainable digital transformation roadmap aligned with the national industrial transformation agenda (Ministry of Industry of the Republic of Indonesia, 2018)

1.2. RESEARCH QUESTIONS

1. What is the current business model of BSU Siliwangi within the value chain of maggot production and its derivative products?
2. How do digital marketing, financial record-keeping, and e-commerce contribute to business performance?
3. What is the impact of grant programs (Kedaireka 2023 and Inovokasi 2024) on strengthening maggot-based biopreneurship at BSU Siliwangi?
4. What business model development strategies can be formulated to enhance the sustainability of maggot-based biopreneurship at BSU Siliwangi?

1.3. PROBLEM-SOLVING APPROACH

This study adopts a descriptive–explanatory case study design using a mixed-methods approach, which includes the following stages:

1. Mapping the Business Model Canvas (BMC) through document analysis (Kaplan & Haenlein, 2010).
2. Assessing the role and contribution of digital marketing, financial record-keeping, and e-commerce through a digital capability audit covering marketing, finance, and operations, drawing on digital marketing and dynamic capability practices (Teece, 2010).
3. Evaluating the impact of grant programs by measuring business performance indicators (Halloran et al., 2018).
4. Conducting in-depth interviews and focus group discussions (FGDs) with management.

1.4. RESEARCH OBJECTIVES

1. To analyze the current business model of BSU Siliwangi within the maggot and derivative product value chain using the Business Model Canvas (BMC) approach.

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

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2. To assess the role and contribution of digital marketing, financial record-keeping, and e-commerce in supporting the business performance of BSU Siliwangi.
3. To evaluate the impact of grant programs (Kedaireka 2023 and Inovokasi 2024) on strengthening maggot-based biopreneurship at BSU Siliwangi.
4. To formulate business model development strategies aimed at enhancing the sustainability of maggot-based biopreneurship at BSU Siliwangi.

1.5. STATE OF THE ART AND NOVELTY

Previous studies have emphasized the Business Model Canvas (BMC) as a powerful tool for designing and evaluating business models (Kaplan & Haenlein, 2010), while business model literature highlights the importance of alignment among strategy, technology, and value innovation (Gill & VanBoskirk, 2016). Digital marketing and social media marketing have been shown to enhance customer reach and engagement (Clark & Taplin, 2012). Meanwhile, the Black Soldier Fly (BSF) sector demonstrates strong potential as a sustainable solution for food and feed production as well as organic waste management (van Huis et al., 2018). The novelty of this study lies in the integration of: (1) a Business Model Canvas (BMC) analysis specifically tailored to the maggot-based biopreneurship ecosystem; (2) an assessment of the role and contribution of digital marketing, financial record-keeping, and e-commerce; and (3) the formulation of business model development strategies to enhance the sustainability of maggot-based biopreneurship, explicitly linked to grant-based interventions (Kedaireka and Inovokasi)

II. LITERATURE REVIEW

2.1. BUSINESS MODEL

Wardhani (2020) defines a business model as a working system used by business actors to generate profits through the optimization of available resources and their alignment with existing market opportunities. This definition emphasizes that business success is strongly determined by the degree of alignment between the implemented business model and the dynamics of the external environment. In line with this perspective, Rantoko (2020) argues that business actors are required to exercise careful judgment in selecting and developing appropriate business models, as internal factors—such as organizational capabilities—and external factors—including market trends, policies, and the level of competition—play a significant role in determining business sustainability.

2.2 DIGITAL BUSINESS MODEL

Weill and Woerner (2018) argue that the primary distinction between digital business models and traditional business models lies in their emphasis on platformization, ecosystem development, and the use of data as a driver of innovation. Firms no longer function solely as producers or product providers but also act as facilitators within broader, interconnected value networks. This view is consistent with Kotler, Kartajaya, and Setiawan (2021), who emphasize that digital businesses create opportunities for micro, small, and medium enterprises (MSMEs) as well as community-based enterprises to optimize value propositions, distribution channels, customer relationships, and revenue streams through the utilization of e-commerce, social commerce, and technology-based financial services (fintech).

2.3 BUSINESS MODEL CANVAS

The Business Model Canvas (BMC) consists of nine building blocks: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure (Osterwalder, 2010).

2.4 BIOPRENEURSHIP (BIO-ENTREPRENEURSHIP)

Biopreneurship represents a contemporary paradigm in business development that is based on the utilization of biological resources, with a strong emphasis on creating economic value through sustainable natural resource management. This concept has evolved alongside the emergence of the bioeconomy, defined as an economic system that relies on the production, processing, and conversion of biological resources into various value-added products, such as food, feed, energy, and biomaterials (OECD, 2009).

Accordingly, biopreneurship can be understood as a form of entrepreneurial activity that is not solely oriented toward financial profit but also integrates social and environmental dimensions into the value creation process (Bugge, Hansen, & Klitkou, 2016).

2.5 MAGGOTS AND THEIR DERIVATIVE PRODUCTS

2.5.1 Maggots

Maggots, or Black Soldier Fly (Hermetia illucens, BSF) larvae, have increasingly attracted attention as an innovative solution for organic waste bioconversion and as a sustainable alternative protein source. BSF larvae are known for their unique ability to decompose various types of organic waste, ranging from household food waste and agricultural residues to livestock manure. This bioconversion process produces larval biomass with high protein content (40–65%) and fat content (15–35%), making it a potential substitute for fish meal and soybean meal in the poultry and aquaculture feed industries (Makkar et al., 2014; van Huis et al., 2018).

2.5.2 Maggot Derivative Products

Maggot cultivation generates a range of primary and derivative products with high economic value, including:

1. Fresh and Dried Maggots (Maggot Meal). Fresh maggots are widely used by small-scale farmers as feed for poultry and fish. In contrast, dried maggots or maggot meal are more commonly utilized in industrial applications due to their longer shelf life, ease of transportation, and storage stability. Elahi et al. (2020) demonstrate that maggot meal can replace a substantial proportion of fish meal in broiler feed without compromising growth performance.
2. Maggot Oil (Larvae Oil). Oil extracted from larvae is rich in lauric acid, comparable to coconut oil, and thus has potential applications as a feed additive, biodiesel feedstock, and even cosmetic ingredients. According to Spranghers et al. (2017), maggot oil represents an environmentally friendly renewable energy source.
3. Frass (Solid and Liquid Organic Fertilizers). Frass is a cultivation residue consisting of a mixture of larval excreta, leftover feed, and dead pupae. Research by Chia et al. (2020) indicates that frass contains relatively high levels of nitrogen, phosphorus, and potassium, making it suitable for use as an organic fertilizer. In Indonesia, frass has been tested as a fertilizer for leafy vegetables and rice, demonstrating its potential to enhance crop productivity (Wahyudi, 2021).
4. Other Diversified Products. In addition to feed and fertilizer, BSF cultivation also produces other products, such as dried pupae for ornamental fish and bird feed, as well as chitin and chitosan powders derived from larval exoskeletons, which have potential applications in the pharmaceutical and industrial sectors (Zheng et al., 2012).

III. RESEARCH METODOLOGY

3.1 Research Design

Research design refers to the conceptual framework used by researchers as a guideline for planning, implementing, and evaluating the research process to ensure that the predetermined objectives are achieved. It functions as a “map” that directs researchers in collecting, analyzing, and interpreting data (Creswell & Creswell, 2018). According to Kerlinger (2006), research design is the plan and structure of inquiry formulated to obtain answers to research questions.

In the context of this study, a qualitative research approach with a descriptive method is employed. Qualitative research is selected because its primary focus is to gain an in-depth understanding of social phenomena related to the implementation of digital business models in strengthening maggot-based biopreneurship at BSU Siliwangi. As stated by Moleong (2019), qualitative research aims to understand phenomena experienced by research subjects—such as behaviors, perceptions, motivations, and actions—through descriptive analysis using words and language within their natural context.

This research design integrates a descriptive qualitative approach with a case study strategy as the primary methodological framework. This combination enables the study to obtain a comprehensive understanding from both conceptual perspectives (digital business model and biopreneurship theories) and practical perspectives (field-level implementation). Specifically, this study adopts a descriptive–explanatory case study approach using a combination of qualitative methods (in-depth interviews, focus group

discussions, and observations) and quantitative methods (analysis of transaction data and digital surveys). This approach is selected to provide a holistic overview of the following aspects:

1. The existing business model of BSU Siliwangi;
2. Digital marketing practices, financial record-keeping, and e-commerce implementation;
3. The impact of grant programs (Kedaireka 2023 and Inovokasi 2024); and
4. Business model development strategies.

3.2. RESEARCH PROCEDURES

The research procedures are structured into five sequential stages as follows:

1. Stage 1: Preparation and Secondary Data Collection (Months 1–2)
   a. Activities: Literature review on maggot-based biopreneurship, digital business, and maggot business models; collection of secondary data, including Kedaireka Grant 2023 reports, Inovokasi Grant 2024 reports, as well as production, financial, and marketing data of BSU Siliwangi.
   b. Output: Baseline report.
2. Stage 2: Mapping the Existing Business Model (Months 2–3)
   a. Activities: Interviews and observations with management and members of BSU Siliwangi to map the Business Model Canvas (BMC), covering the nine elements: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure.
   b. Output: Business Model Canvas map of BSU Siliwangi comprising the nine core elements.
3. Stage 3: Assessment of Digital Marketing, Financial Record-Keeping, and E-Commerce (Months 3–4)
   a. Activities: Surveys and in-depth interviews focusing on digital marketing practices, marketplace utilization, financial record-keeping systems, and readiness for technology adoption.
   b. Output: Assessment report on digital marketing, financial record-keeping, and e-commerce.
4. Stage 4: Evaluation of Grant Impacts (Months 4–5)
   a. Activities: Analysis of the impacts of the Kedaireka and Inovokasi grants on strengthening marketing activities, financial record-keeping, production equipment, and human resources.
   b. Output: Grant impact evaluation report.
5. Stage 5: Strategy Formulation and First-Year Roadmap Development (Month 6)
   a. Activities: Development of strategic recommendations for business model enhancement based on research findings.
   b. Output: Business model development strategy.

Overall, the Business Model Canvas (BMC) is developed by considering its nine core building blocks, all of which are summarized within a single, one-page canvas to provide a comprehensive overview of the business model.

3.3. EXPECTED RESULTS AND PERFORMANCE INDICATORS

1. Expected Results

a. A Business Model Canvas (BMC) map of BSU Siliwangi;
b. An assessment report on digital marketing, financial record-keeping, and e-commerce;

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

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c. An impact evaluation report on the Kedaireka 2023 and Inovokasi 2024 grants in strengthening maggot-based biopreneurship at BSU Siliwangi;

d. Strategic recommendations for business model development;

e. Publication of a scientific article in an international Copernicus-indexed journal.

2. Performance Indicators

a. Primary Output: Business Model Canvas (BMC) document.

b. Performance Indicator: Publication of an article in an international Copernicus-indexed journal.

IV. Results and Discussion

4.1. Overview of BSU Siliwangi

BSU Siliwangi is located at Jl. Sukamulya RT 02/RW 03, Sukasari Sub-district, East Bogor District, and was formally established under Decree No. SK600/39-SKS/2019. BSU Siliwangi operates in collaboration with the Basiba Waste Bank of Bogor City, which is supervised by the Bogor City Environmental and Forestry Agency (DLHK) and the Ministry of Environment and Forestry (KLHK). BSU Siliwangi adopts the motto *"ELING (Environmental Education)"* as its guiding principle.

BSU Siliwangi has developed several institutional and operational foundations, including organizational governance guidelines, a simple financial management and recording system, a formal organizational structure, a digital marketing platform, a Business Identification Number (*Nomor Induk Berusaha*), and registered intellectual property rights for its logo (Nurendah et al., 2023). At present, waste processed by BSU Siliwangi is categorized into two main types: inorganic waste and organic waste, primarily household food waste.

To enhance management capacity and optimize member resources, BSU Siliwangi has implemented several strategic certification programs. These include Circular Economy Certification organized by PPM IBIK and Excel-based Financial Reporting Certification conducted by PPA IBIK. The Circular Economy Certification aims to provide a comprehensive understanding of circular economy concepts and practices, enabling BSU members to manage waste more efficiently and transform it into valuable resources. In addition, BSU Siliwangi obtained Hazard Analysis and Critical Control Points (HACCP) certification from PT Registra Indonesia on September 30, representing a significant step toward improving the quality and safety of maggot products. As part of the Creative Innovation Program for Vocational Partners, this certification ensures that maggot production processes at BSU Siliwangi comply with internationally recognized food safety standards (Nurendah et al., 2024).

4.2 BUSINESS MODEL CANVAS (BMC) MAPPING AT BSU SILIWANGI

At BSU Siliwangi, the implementation of the Business Model Canvas (BMC) is essential for examining how waste management activities, maggot cultivation, and the production of derivative products create added value, expand market networks, and support business sustainability. The business model map of BSU Siliwangi illustrates the integration of value creation processes across the waste management and maggot biopreneurship ecosystem, as presented in **Figure 1**.

Key Partners	Key Activities	Value Proposition	Customer Relationships	Customer Segments
1. Koperasi Harapan Bogor 2. Safar Integrated Farm 3. Basiba Waste Bank 4. IBIK (Institut Bisnis dan Informatika Kesatuan) 5. Community Groups and Startups	1. Waste Collection 2. Maggot Cultivation 3. Production of Maggot Meal/Pellets 4. ELING (Environmental	1. Fresh Maggot Products 2. Dried Maggot Products 3. Larvae Oil 4. Organic Fertilizers	1. Environmental Education Programs 2. Social Media Engagement (Instagram, TikTok)	1. Fish and Poultry Farmers 2. Feed Industry 3. Environmental Communities 4. Micro, Small, and Medium Enterprises (MSMEs)

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

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<table>
<tr><td></td><td>Education) Programs
5. Digital Marketing</td><td rowspan="2">5. Circular Economy-Based Solutions
6. HACCP Certification</td><td>3. Official Website (eling.id)
4. Personalized Orders
5. Environmentally Friendly Brand Image</td><td>5. External Regional Partners</td></tr>
<tr><td colspan="2">Key Resources
1. Cultivation Land
2. Bioponds
3. Pelletizing Machine
4. BSF Larvae Stock
5. Certified Human Resources
6. Website and Social Media Platforms</td><td colspan="2">Channels
1. Social Media Platforms
2. Official Website (eling.id)
3. Distribution Partners
4. Direct Sales</td></tr>
<tr><td colspan="3">Cost Structure
1. Raw Materials (Organic Waste)
2. Production Operational Costs
3. Labor Costs
4. Distribution and Certification Costs
5. Technology Investment</td><td colspan="2">Revenue Streams
1. Maggot Sales
2. Organic Fertilizer Sales
3. Larvae Oil Sales
4. Eggs and Prepupae Sales
5. Distribution Partnerships</td></tr>
</table>

Figure 1. Business Model Canvas (BMC) of BSU Siliwangi

Based on the BMC mapping, it is evident that BSU Siliwangi possesses a strong foundation for developing maggot-based biopreneurship. The integration of environmental, social, and economic aspects within its business model indicates that BSU Siliwangi is not solely oriented toward financial profit but also contributes to sustainability and the strengthening of the circular economy at both local and national level

4.3 ASSESSMENT REPORT ON DIGITAL MARKETING, FINANCIAL RECORD-KEEPING, AND E-COMMERCE

The assessment of digital marketing, financial record-keeping, and e-commerce, as presented in **Table 1**, provides an overview of the current level of digital capability and business performance at BSU Siliwangi.

Table 1. Assessment of Digital Marketing, Financial Record-Keeping, and E-Commerce

Aspect	Current Condition	Strengths	Weaknesses	Strengthening Recommendations
Digital Marketing	Utilizes Instagram, TikTok, WhatsApp, and the website *e-ling.my.id*	Consistent green branding and educational content	Limited use of SEO, digital advertising, and analytics tools	Implement SEO strategies, utilize paid digital advertising, and leverage Google Analytics
Financial Record-Keeping	Uses basic Excel-based recording	Initial transparency is relatively adequate	Non-automated system, prone to errors, and non-standardized reports	Adopt cloud-based accounting applications and provide financial management training for staff
E-Commerce	Internal website and social commerce channels	Able to reach local consumers	Not yet integrated with national marketplaces and limited logistics capacity	Establish online stores on major marketplaces, integrate digital payment systems, and strengthen order management

The assessment results indicate that BSU Siliwangi has initiated a digital transformation process in the areas of marketing, finance, and e-commerce; however, the implementation remains at an early stage and requires further strengthening. The integration of these three aspects is essential for creating a more robust digital business model ecosystem. By implementing data-driven digital marketing strategies, standardized financial record-keeping, and optimized e-commerce utilization, BSU Siliwangi can enhance its

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ISSN: 2509-0119.

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competitiveness while reinforcing its position as a pioneer of maggot-based biopreneurship in Indonesia. The mapping of these three aspects is presented in Table 2.

Table 2. SWOT Analysis

	Strengths 1. Digital Marketing a. Products have a clear unique selling point (USP) related to environmental sustainability. b. Branding is supported by the credibility of an academic institution. c. Social media platforms have begun to be utilized. 2. Financial Record-Keeping a. Awareness of transaction recording practices has been established. b. Potential integration with university administrative systems. c. Small business scale allows for easier control and monitoring. 3. E-Commerce a. Products target niche market segments (animal feed and compost) b. Online promotion costs are lower compared to offline promotion. c. Institutional backing from the university enhances customer trust.	Weaknesses 1. Digital Marketing a. Limited human resources with expertise in digital marketing strategies. b. Inconsistent content in terms of frequency and quality. c. Lack of systematic branding planning. 2. Financial Record-Keeping a. Financial recording remains manual (Excel-based) and inconsistent. b. Limited availability of formally trained accounting personnel. 3. E-Commerce a. Online marketplaces have not been optimally utilized. b. Online store design remains basic. c. Logistics management for biological products is not yet well organized
Opportunities 1. Digital Marketing a. Increasing consumer preference for environmentally friendly products. b. Continuous growth in social media users. c. Potential collaboration with animal lover communities and livestock farmers. 2. Financial Record-Keepin a. Wide availability of digital accounting applications. b. Support for financial literacy and capacity-building programs. c. Opportunities to access external funding through well-prepared financial reports. 3. E-Commerce a. Rapid growth in online shopping trends b. Government support for MSME digitalization initiatives. c. Potential for regional and global market expansion.	SO Strategies (Strength–Opportunities) 1. Leverage the environmentally friendly product USP to strengthen digital branding, supported by the university as a strategic partner. 2. Utilize e-commerce platforms to expand market reach, supported by digital financial record-keeping to enhance transaction transparency.	WO Strategies (Weakness–Opportunities) 1. Conduct integrated training programs on digital marketing, digital accounting, and e-commerce for BSU management. 2. Integrate online sales recording systems with simple financial applications to reduce the risk of recording errors.

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ISSN: 2509-0119.

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Threats 1. Digital Marketing a. Intense competition in digital marketing. b. Frequent changes in social media algorithms. c. Risk of negative stigma associated with maggot-based products. 2. Financial Record-Keeping a. Risk of recording errors. b. Inaccurate reports may hinder business evaluation and decision-making. c. Limited internet access may impede digitalization efforts. 3. E-Commerce a. Intense price competition in e-commerce platforms. b. High logistics costs that may reduce profit margins. c. Risk of fraud or customer complaints	ST Strategies (Strength–Threats) 1. Strengthen branding narratives based on environmental sustainability to mitigate the impact of price competition in e-commerce. 2. Utilize well-maintained financial records to control logistics costs and maintain profitability.	WT Strategies (Weakness–Threats) 1. Develop Standard Operating Procedures (SOPs) for online store management, transaction recording, and digital content creation to reduce internal weaknesses and minimize external threats. 2. Optimize collaboration with partners (logistics providers, livestock communities, and marketplaces) to reduce operational risks.

4.4. REPORT ON THE IMPACT OF GRANT PROGRAMS (KEDAIREKA 2023 AND INOVOKASI 2024) ON THE STRENGTHENING OF MAGGOT-BASED BIO-ENTREPRENEURSHIP AT BSU SILIWANGI

4.4.1. Impact Assessment Method

The Capacity Building Program (Kedaireka 2023) and the Inovokasi Program (Inovokasi 2024), implemented in collaboration with BSU Siliwangi, were designed with integrated objectives: to strengthen maggot production capacity, improve governance and financial record-keeping, obtain quality certifications, develop digital marketing channels, and pilot a digital business model to enhance business sustainability. This report summarizes the achievements, tangible outcomes and impacts, supporting evidence, gap analysis, and follow-up recommendations.

The impacts of these two grant programs can be considered complementary and mutually reinforcing. The Kedaireka 2023 grant played a crucial role in establishing the initial foundation through the strengthening of physical infrastructure, enhancement of human resource capacity, and improvement of organizational governance. Through these interventions, BSU Siliwangi was able to improve operational quality, refine financial recording systems, and develop a more professional managerial foundation. Improved infrastructure also enabled a more efficient increase in production capacity for maggots and their derivative products.

Meanwhile, the Inovokasi 2024 grant marked a significant step toward the digital transformation phase. Support from this program encouraged BSU Siliwangi to leverage digital technologies in marketing, distribution, and customer relations. Through the adoption of e-commerce platforms, social media, and digital-based recording systems, BSU Siliwangi began to access broader markets, extending beyond local community-based markets toward regional and even national market potential. With this expanded market orientation, BSU Siliwangi has increasingly positioned itself as a key actor in the maggot-based bio-entrepreneurship value chain.

Thus, the combined implementation of Kedaireka 2023 and Inovokasi 2024 has fostered a more competitive, sustainable, and inclusive bio-entrepreneurial ecosystem. BSU Siliwangi is no longer viewed merely as an organic waste processor producing alternative feed, but also as a role model for circular economy–based bio-entrepreneurship. This model integrates three core dimensions of sustainable development:

1. Environmental dimension, through tangible contributions to reducing organic waste volumes and decreasing reliance on conventional feed sources.

2. Social dimension, by promoting local community empowerment, job creation, and environmental education within the community.
3. Economic dimension, by creating added value through the diversification of maggot-derived products, access to digital markets, and cross-sector collaboration opportunities.

The transformation achieved demonstrates that grant funding functions not merely as short-term intervention, but as a catalyst guiding BSU Siliwangi toward long-term sustainability. Through digital innovation integrated with circular economy principles, BSU Siliwangi has become increasingly relevant as a reference model for bio-entrepreneurship development at both national and global levels.

4.4.2. Key Achievements (Outputs and Outcomes)

The following summarizes measurable achievements and documented evidence reported:

1. Increased production capacity and product diversification.
2. Investment in facilities and appropriate technologies, including significant equipment support that has improved process efficiency (e.g., drying and packaging), enabling larger-scale production.
3. Enhanced human resource capacity and governance.
4. Development of governance guidelines, job descriptions, organizational structure, Excel-based financial recording systems, and other internal documents (guidelines and templates provided in the appendices).
5. Issuance of a Business Identification Number (NIB) and registration of logo intellectual property rights, strengthening legal compliance and branding.
6. Quality assurance and food safety certification.
7. BSU Siliwangi obtained HACCP certification issued by PT Registra Indonesia, representing a strategic achievement for formal market access and export potential (certificates and event documentation are included in the report).
8. Marketing, networking, and market development.
9. Market expansion initiatives.
10. Establishment of partnerships and memoranda of understanding (MOUs) with strategic partners (e.g., Koperasi Harapan Bogor as a raw material supplier; Safar Integrated Farm as a buyer and distribution partner).
11. Development and utilization of digital platforms.
12. Direct economic impacts.

4.4.3. Impact Analysis (Benefit Dimensions and Value Added)

The Kedaireka 2023 and Inovokasi 2024 grant programs have demonstrably generated tangible changes across three key dimensions for BSU Siliwangi: technical, institutional, and market aspects. From a technical perspective, Kedaireka provided critical support through improvements in production infrastructure, provision of equipment, and enhancement of human resource skills. These interventions strengthened production capacity for maggots and their derivative products while establishing more efficient operational standards. Institutionally, the grant contributed to strengthening organizational governance, including financial recording systems, management structures, and community-based participatory management mechanisms.

In contrast, the Inovokasi 2024 program accelerated digital transformation and market orientation. Through this program, BSU Siliwangi was encouraged to strengthen branding and expand access through e-commerce platforms and digital marketing strategies. With such support, BSU Siliwangi not only possesses a solid production foundation but also demonstrates readiness to compete in broader markets using a more modern and long-term–oriented approach.

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
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The synergy between the two grant programs has created a complementary ecosystem: Kedaireka 2023 reinforced the foundations of production capacity and governance, while Inovokasi 2024 advanced digitalization, business model mapping, and broader market readiness. The combined impact has significantly enhanced BSU Siliwangi's competitiveness and relevance as an innovative actor in maggot-based bio-entrepreneurship.

4.5. Recommendations for Business Model Development Strategy

The business model development strategy for BSU Siliwangi, based on the Business Model Canvas (BMC) framework, is presented in Table 3 below.

Table 3. Business Model Development Strategy (BMC) for BSU Siliwangi

BMC Aspect	Existing Condition	Strengthening / Development Strategy
Key Partners	Partnerships with Harapan Bogor Cooperative (raw materials), Safar Integrated Farm (distribution), Bank Sampah Basiba, and IBIK	Expand partnerships with local Environmental Agencies (DLHK), traditional markets, and catering services (raw material supply contracts); collaborate with feed and aquaculture industries; engage agritech startups and impact investors
Key Activities	Waste collection, maggot cultivation, production of fresh/dried maggots and organic fertilizer, basic digital marketing	Develop R&D for downstream products (larval oil, chitin/chitosan); implement continuous HACCP-based SOPs; adopt analytics-driven digital marketing; strengthen national distribution logistics
Value Propositions	Fresh/dried maggot products, organic fertilizer, prepupae seedlings; environmentally friendly branding	Diversify into high-value products (premium maggot meal, pellets, liquid fertilizer, larval oil); strengthen green branding with the narrative "from waste to value"; obtain quality certifications for industrial and export markets
Customer Relationships	Personal orders, environmental education (ELING program), social media interaction	Develop digital CRM (WhatsApp Business API, marketplaces); introduce subscription programs for farmers; implement customer loyalty programs for MSMEs; apply educational content-based storytelling
Customer Segments	Fish and poultry farmers, agricultural MSMEs, environmental communities, out-of-area partners	Expand to large-scale feed industries, export-oriented segments (processed dried products), and environmentally conscious urban consumers (eco-friendly products)
Key Resources	Land, bioponds, pellet machines, shelving racks, trained human resources, e-ling.my.id website	Add HACCP-certified personnel; secure raw material supply contracts; implement lightweight ERP applications (integrating production–sales–finance); position e-Ling brand IP as a strategic asset
Channels	Social media (Instagram, TikTok), e-ling.my.id website, direct sales, cooperative partners	Optimize major marketplaces (Shopee, Tokopedia, Lazada); integrate payment gateways on the website; strengthen SEO-based content and paid digital advertising; participate in trade fairs and exhibitions
Cost Structure	Organic raw material costs, production operations, labor, distribution, certification	Improve cost efficiency through raw material contracts; invest in appropriate technologies; allocate budgets for digital marketing; fund continuous quality audits; reinvest in R&D
Revenue Streams	Sales of fresh/dried maggots, organic fertilizer, BSF eggs, prepupae seedlings	Add revenue sources through larval oil and chitin/chitosan sales; feed subscription schemes; long-term contracts with feed industries; income from education and training programs (ELING)

Through the proposed strengthening strategies, the Business Model Canvas (BMC) is directed toward the development of a more integrated and competitive business model, with the capacity to penetrate national and global markets, as presented in Table 4 below

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
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Table 4. Strategic Roadmap for Business Model Development of BSU Siliwangi

BMC Aspects	Short Term (0–1 Year)	Medium Term (2–3 Years)	Long Term (≥ 3 Years)
Key Partners	Local partners: traditional markets, catering services, Environmental Agency (DLHK), waste cooperatives	Feed industries, agritech startups, fisheries cooperatives, local impact investors	Multinational feed companies, international institutions, global investors
Key Activities	SOP standardization, human resource training, initial production scale-up	R&D of derivative products (maggot meal, pellets, liquid fertilizer, larval oil)	Industrial-scale production; chitin/chitosan research for pharmaceutical and cosmetic applications
Value Propositions	Fresh and dried maggot products and organic fertilizer; green branding	High-value product diversification; HACCP certification	HACCP-, ISO-, and organic-certified products for export markets
Customer Relationships	Customer service via WhatsApp Business, ELING environmental education programs, social media engagement	Digital CRM, feed subscription programs, customer loyalty schemes	Long-term contractual relationships with global feed industries
Customer Segments	Fish and poultry farmers, agricultural MSMEs, local communities	National feed industries, urban eco-friendly communities	Export markets (maggot meal, larval oil); pharmaceutical and global green-living industries
Key Resources	Land, grant-supported machinery (bioponds, pellet machines, dryers), basic human resources, e-ling.my.id website	HACCP-certified personnel, cloud-based accounting applications, Google Analytics	Advanced production technology, integrated ERP systems, global intellectual property rights for the brand
Channels	Social media (Instagram, TikTok), e-ling.my.id website, direct sales	National marketplaces (Shopee, Tokopedia), payment gateways, national trade exhibitions	Global marketplaces (Alibaba, Amazon), export distribution networks, ERP-enabled platforms
Cost Structure	Raw material costs, production operations, local distribution	R&D investment, digital marketing expenditure, HACCP quality audits	Global certification costs, export logistics, advanced research and joint ventures
Revenue Streams	Sales of fresh/dried maggot products, organic fertilizer, BSF eggs and prepupae	Feed subscription schemes, national supply contracts, ELING training services	Global supply contracts, technology licensing, premium chitin/chitosan products

V. CONCLUSION AND RECOMMENDATIONS

5.1. CONCLUSIONS

1. The Business Model Canvas (BMC) mapping indicates that BSU Siliwangi has developed a relatively comprehensive business model structure encompassing all nine BMC elements. Its customer segments include fish and poultry farmers as well as organic fertilizer consumers. The core value propositions lie in environmentally friendly and economically valuable products, namely fresh maggot, dried maggot, and frass. Marketing channels are still dominated by direct sales and basic digital platforms, while customer relationships are primarily built through local community engagement. Revenue streams are generated from the sales of maggot and its derivative products, supported by key resources such as production facilities, human resources, and partner networks. The main activities include maggot cultivation, product processing, and environmental education. Key partners consist of waste banks, local government agencies, and supporting institutions. The cost structure remains relatively simple, with production operations and marketing expenses as the major components.
2. Digital marketing has proven effective in expanding BSU Siliwangi's promotional reach, although its application remains limited to social media and local marketplaces. Financial record-keeping has begun to adopt simple digital applications, improving the accuracy and transparency of financial reports. E-commerce has contributed to broader market access; however, challenges related to logistics and product standardization persist.

3. Grant programs have generated significant positive impacts on strengthening BSU Siliwangi, particularly in enhancing production capacity, improving governance, and adopting digital technologies. The grants have supported the procurement of equipment, training, and mentoring, thereby increasing productivity, product quality, and business sustainability.
4. The proposed development strategy emphasizes strengthening branding through digital marketing, diversifying derivative products (such as maggot meal, liquid organic fertilizer, and maggot oil), and enhancing quality certifications to expand market access. The integration of digital technologies—especially cloud-based financial recording, traceability systems, and e-commerce platforms—has become a strategic priority to improve efficiency and competitiveness. Furthermore, expanding partnership networks with feed industries, government agencies, and communities is considered a key strategy to support the sustainability of maggot-based bioentrepreneurship at BSU Siliwangi.

5.2. RECOMMENDATIONS

1. Regarding Business Model Analysis (BMC)
   a. BSU Siliwangi should periodically update its BMC to align with market dynamics and regulatory changes.
   b. Greater emphasis should be placed on strengthening marketing channels and customer relationships to expand market reach and enhance customer loyalty.
2. Regarding Digital Marketing, Financial Record-Keeping, and E-Commerce
   a. Digital marketing should be optimized through the application of SEO, content marketing, and social commerce strategies.
   b. The adoption of cloud-based financial recording systems is recommended to improve transparency and accountability.
   c. Market access should be expanded by entering national and global marketplaces, accompanied by strengthened logistics systems.
3. Regarding the Impact of Grant Programs
   a. Future grant programs are recommended to focus on product innovation, quality certification, and branding development.
   b. A continuous monitoring and evaluation system should be established to clearly measure and document grant impacts.
4. Regarding Business Model Development Strategy
   a. Short-term: increase brand awareness through digital campaigns and environmental education initiatives.
   b. Medium-term: diversify derivative products supported by certifications and improved packaging.
   c. Long-term: expand partnerships with the feed industry and agricultural sector, and explore export markets to strengthen long-term business sustainability.

ACKNOWLEDGMENT

Thank you to the Institut Bisnis dan Informatika Kesatuan for providing excellent support and funding for the implementation of this research.

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