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Integrating Decision Support Systems in Sustainable Coffee Entrepreneurship: A Feasibility Analysis of Bedhag Kopi's Robusta Coffee Business in Rural Indonesia

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ABSTRACT
Background: Sustainable coffee entrepreneurship in rural Indonesia faces persistent challenges in operational efficiency, marketing, and financial management. Bedhag Kopi, a micro-enterprise producing Robusta ground coffee in Jember Regency, exemplifies these constraints within the local agroindustry context. Despite having complete business legality, its managerial structure, production capacity, and marketing strategies remain suboptimal. The growing emphasis on digital transformation and data-driven decision-making offers potential solutions to strengthen business feasibility and sustainability for small coffee producers.
Aims: This study aims to evaluate the business feasibility and development potential of Bedhag Kopi by integrating a Decision Support System (DSS) framework. The research focuses on assessing multi-aspect feasibility—including legal, production, marketing, human resources, environmental, and financial dimensions—to identify strategic directions for sustainable business growth.
Methods: A descriptive quantitative approach was employed using DSS version 2.0 to analyze the enterprise's feasibility indicators. Data were collected through structured interviews and financial records, and processed using expert-based scoring analysis to generate performance classifications and development recommendations across business aspects.
Results: Findings show that Bedhag Kopi is financially feasible, with a Benefit-Cost Ratio of 1.80, Payback Period of 6.01 years, Net Present Value of IDR 1.48 billion, and Internal Rate of Return of 52.84%. Non-financial aspects—including production, marketing, and human resources—demonstrate moderate feasibility requiring targeted improvement interventions.
Conclusion: Integrating DSS into rural coffee entrepreneurship enables systematic evaluation and informed strategic planning. The approach enhances managerial decision-making, financial viability, and environmental sustainability, offering a replicable digital model for small-scale agribusinesses in emerging economies pursuing sustainable competitiveness.

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INTRODUCTION

The integration of digital technology into rural entrepreneurship has become a crucial pillar in advancing sustainable development, especially in emerging economies where microenterprises are the backbone of local livelihoods (Raja et al., 2022; Tshikovhi et al., 2023). The coffee sector in Indonesia exemplifies this transformation, serving as both a cultural heritage and an economic driver for rural communities. However, many small enterprises struggle to maintain competitiveness due to limited managerial capacity, fluctuating market prices, and inconsistent production quality. Bedhag Kopi, a Robusta coffee microenterprise located in Jember Regency, reflects these challenges while also representing the potential of local innovation in rural settings. Although the business has obtained legal legitimacy and consumer trust, its marketing reach and operational systems remain constrained. The implementation of Decision Support Systems (DSS) provides a viable solution for addressing such managerial inefficiencies through data-driven analysis and structured decision-making (Sarker, 2021; Zhang, 2025). Applying DSS within the context of small coffee enterprises contributes to sustainable

entrepreneurship by optimizing feasibility across financial, production, and environmental domains (Hadi et al., 2023; León Chilito et al., 2025).

The urgency of this study arises from the increasing need to strengthen data-informed decision-making in small agribusiness sectors. In most rural Indonesian enterprises, business planning relies heavily on experiential knowledge rather than analytical frameworks, which limits adaptability to market changes and global competition. Integrating DSS into such contexts provides an opportunity to bridge the gap between traditional entrepreneurial practices and modern digital management tools (Petraki et al., 2025; Rajagopal et al., 2022). As digital transformation expands across developing regions, leveraging technology to enhance rural productivity aligns with both national and global sustainability agendas. The rural coffee sector, in particular, offers a strategic entry point for digital intervention due to its export potential and value-chain complexity. Therefore, assessing Bedhag Kopi's business through a DSS framework provides not only practical recommendations for growth but also theoretical insights into rural digitalization and entrepreneurship innovation.

The broader relevance of this research extends to the discourse on inclusive digital economies, where small and medium enterprises (SMEs) are positioned as key enablers of equitable development (Jin & Liu, 2024; Kumar et al., 2024). Despite the proliferation of digital tools, adoption among rural enterprises remains limited by infrastructure, literacy, and cost barriers. A DSS-based framework can democratize access to analytical insights, supporting local entrepreneurs in making evidence-based decisions that enhance sustainability, financial viability, and resilience. Furthermore, the Indonesian coffee industry serves as an ideal case for exploring this integration, as it combines socio-cultural significance with growing digital opportunities. By situating Bedhag Kopi within this transformative landscape, the study highlights how intelligent decision systems can empower local enterprises to thrive amid global competition and environmental challenges (Sedky, 2024).

This study is driven by the rationale that the adoption of Decision Support Systems in rural entrepreneurship represents a transformative approach to improving business sustainability and competitiveness. Microenterprises such as Bedhag Kopi face multifaceted challenges that require integrative analytical solutions rather than fragmented interventions. The DSS framework provides a systematic model for evaluating financial, operational, and marketing aspects simultaneously, ensuring decisions are grounded in measurable performance metrics (Alojail et al., 2023; Kim, 2022). By implementing DSS version 2.0, entrepreneurs can obtain a comprehensive understanding of their business feasibility and identify areas for strategic improvement. From a policy perspective, this research aligns with Indonesia's digital economy roadmap that emphasizes rural innovation and entrepreneurship empowerment. Theoretically, it enriches the discourse on digital transformation in community-based enterprises, emphasizing that technology can coexist with traditional values in fostering sustainability. Practically, it establishes a model that can be replicated across other micro agribusinesses, thereby expanding the impact of digitalization beyond urban sectors (Lei et al., 2025; Salam et al., 2025).

Decision Support Systems (DSS) have been widely utilized across diverse industries to enhance analytical decision-making and operational efficiency. (Williams et al., 2025) demonstrated that integrating DSS in waste management systems optimized resource utilization and financial planning, underscoring its cross-sectoral relevance. (Martins et al., 2025) developed a GIS-based DSS for infrastructure planning, proving its utility in balancing economic and environmental priorities. (Raina et al., 2025) applied a web-based SMART DSS model to evaluate SME financing, establishing its contribution to inclusive financial management. (D'Adamo et al., 2025) conducted an economic feasibility study on renewable energy systems, highlighting the role of DSS in sustainable project evaluation. (Blečić et al., 2025) expanded DSS applications to renewable energy communities, linking environmental and socioeconomic decision layers. Similarly, (Istaiteyeh, 2025) explored how DSS-driven frameworks in social entrepreneurship enhance financial inclusion and local empowerment. These findings collectively illustrate that DSS methodologies are adaptable tools for achieving sustainable and data-driven development outcomes across business contexts.

Complementary studies have advanced DSS models by integrating artificial intelligence and machine learning to support strategic forecasting and risk management. (Deng, 2025) utilized genetic algorithms to improve enterprise financial control systems, demonstrating DSS adaptability under uncertainty. (Fakhroleslam, 2025) introduced a SaaS-based simulation platform for modeling industrial networks, showing that cloud-based DSS solutions can enhance scalability. (Seikh & Dey, 2025) developed a fuzzy-based DSS to manage decision uncertainty, improving model precision in dynamic business environments. Moreover, (Raina et al., 2025) emphasized the accessibility of DSS in SMEs, suggesting that digital tools can democratize analytical processes even in resource-limited settings. Collectively, these studies emphasize the increasing significance of DSS as an integrative approach for optimizing financial feasibility, operational decision-making, and sustainability in entrepreneurship ecosystems.

Although the application of DSS has been explored extensively in industrial and infrastructure contexts, research addressing its implementation within small-scale rural entrepreneurship remains limited. There is a lack of empirical evidence on how DSS can be adapted to the constraints and opportunities of micro agribusinesses, especially in developing economies like Indonesia. Existing models predominantly emphasize high-capacity enterprises with advanced technological infrastructure, leaving microenterprises underserved. Moreover, few studies have examined how DSS can facilitate the alignment between local knowledge systems and data-driven management. The contextual uniqueness of Bedhag Kopi as a rural coffee enterprise provides an opportunity to fill this knowledge gap by demonstrating a participatory, localized, and sustainable model of DSS application.

The primary purpose of this study is to analyze how the integration of Decision Support Systems (DSS) enhances the feasibility and sustainability of micro-scale coffee enterprises in rural Indonesia. This research hypothesizes that implementing DSS within Bedhag Kopi's business structure will significantly improve managerial effectiveness, financial planning, and operational efficiency. It assumes that the use of DSS will lead to evidence-based decision-making, minimizing uncertainty and supporting long-term sustainability. Furthermore, the study seeks to validate the adaptability of DSS as a framework for small-scale entrepreneurship beyond industrial contexts. It also aims to contribute to policy and practice by providing insights into how digital decision-making tools can be effectively scaled to rural environments. Ultimately, this study aspires to position DSS not merely as a technical instrument but as a transformative enabler of inclusive and sustainable coffee entrepreneurship in Indonesia.

METHOD

Research Design

This study employed a descriptive quantitative research design integrated with a Decision Support System (DSS) Version 2.0 to analyze the multi-aspect feasibility of a rural coffee enterprise, Bedhag Kopi, in Jember Regency. The design was structured to assess both financial and non-financial dimensions—including production, marketing, human resources, environmental, and legal factors—within a sustainable entrepreneurship framework. The DSS approach was selected because it combines computational modeling and expert judgment, allowing for multi-criteria evaluation of business performance (Ferrara et al., 2023; Sr\djević & Sr\djević, 2024). The system architecture is built on a modular design that enables data entry, weighting, and result visualization. The DSS operates under a multi-criteria decision analysis (MCDA) principle, which integrates both quantitative financial indicators and qualitative expert evaluations to produce a composite feasibility score.

The structure of the DSS design used in this study is summarized in Figure 1, which illustrates the analytical flow from data input to decision recommendation.

The design allows for flexibility in weighting and indicator adjustments, enabling application to various microenterprise contexts. The integration of digital analysis enhances the reliability and repeatability of results, making it suitable for sustainability-oriented business assessments (Williams et al., 2025).

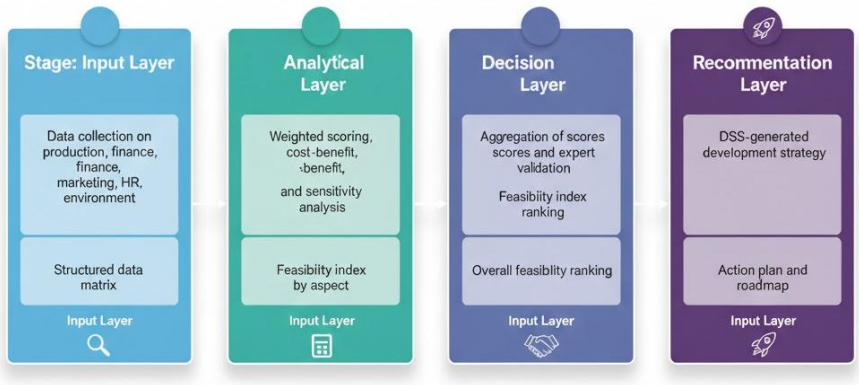

Figure 1. Structure of Decision Support System (DSS) Version 2.0 for Business Feasibility Evaluation

Participants

The participants consisted of key stakeholders from Bedhag Kopi, including the owner, production staff, marketing personnel, and local government representatives from the cooperative and SME agency. A total of 10 participants were purposively selected based on their knowledge of the enterprise's operations and business environment. This sampling strategy ensured comprehensive input across all functional domains evaluated by the DSS. The inclusion of multiple actors allowed for triangulation between qualitative insights and quantitative data generated through system analysis (Deutsch et al., 2024; Köhler, 2024). Ethical approval and informed consent were obtained from all participants before data collection, aligning with standard research ethics for social and community-based studies.

Instrument

The main research instrument was the Decision Support System (DSS) Version 2.0, which was adapted and validated for microenterprise feasibility assessment. Supporting instruments included:

1. Structured Interview Guide: Used to gather contextual data on operational, marketing, and human resource practices.
2. Feasibility Assessment Matrix: Containing six core dimensions—legal, human resources, production, marketing, environment, and finance—with a five-point Likert scoring scale.
3. Financial Feasibility Templates: To calculate Net Present Value (NPV), Benefit-Cost Ratio (BCR), Payback Period (PP), and Internal Rate of Return (IRR).

Table 1 summarizes the analytical indicators used in each domain of the DSS.

Table 1. Feasibility Indicators and Measurement Metrics

Aspect	Indicators	Measurement Tools	Expected Outcome
Legal	Business registration, licensing	Document validation	Compliance level
Production	Capacity, efficiency, technology use	Observation checklist	Productivity index
Marketing	Channel diversity, promotion strategy	Survey and interview	Market expansion score
Human Resources	Skill level, training, job structure	Employee assessment	HR competency rating
Environment	Waste management, resource efficiency	Site observation	Sustainability rating

The DSS was calibrated through a validation session involving two academic experts and one SME consultant, ensuring that the system's decision rules reflected real-world business logic and sector-specific sustainability standards (Mandal et al., 2024; Merchán-Cruz et al., 2025).

Data Analysis Plan

The data analysis process integrated both descriptive statistics and multi-criteria DSS computation. Raw data from financial statements, production records, and marketing evaluations were first normalized and entered into the DSS interface. Weighted scoring was applied to each aspect according to expert-defined importance levels: finance (30%), production (20%), marketing (20%), human resources (15%), environment (10%), and legal (5%). The DSS generated a composite feasibility index (CFI) based on the following formula:

$$CFI = \sum_{i=1}^{n} (Wi \; x \; Si)$$

where Wi_is the weight of each aspect and Si represents the normalized score from 0 to 1. The output provided both aspect-specific feasibility scores and an overall business feasibility classification (High, Moderate, or Low).

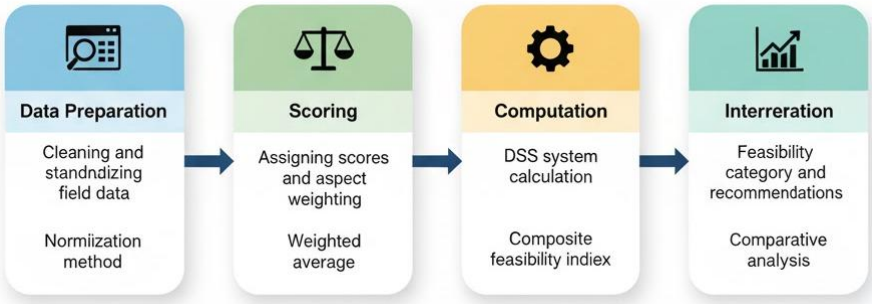

Figure 2. Data Analysis Flow Using DSS Framework

Additionally, financial analysis was conducted using discounted cash flow (DCF) methods to estimate BCR, NPV, PP, and IRR values, providing quantitative evidence of business sustainability. Cross-validation was performed through stakeholder consultation to ensure that DSS recommendations were contextually grounded. The combination of system-based analysis and expert validation enhanced methodological robustness and reliability (Amiri et al., 2024; Lin & Chen, 2024).

Additional Methodological Strengths

To ensure the credibility of results, the study incorporated three complementary validation strategies:

1. Triangulation of Data Sources to compare DSS outputs with stakeholder feedback.
2. Sensitivity Analysis to test the robustness of DSS-generated feasibility rankings under varying financial assumptions.
3. Replicability Check using DSS simulation under alternative market price and cost scenarios.

These additional procedures enhanced the analytical depth and ensured that findings align with the journal's focus on sustainable entrepreneurship, socio-environmental innovation, and digital transformation in local business ecosystems.

RESULTS AND DISCUSSION

Results

The Decision Support System (DSS) Version 2.0 generated comprehensive results on the feasibility of Bedhag Kopi's Robusta coffee business. The system evaluated six major dimensions: legal, human resources, production, marketing, environmental, and financial. Based on the DSS composite feasibility index, the enterprise achieved an overall score of 83.6%, indicating a high feasibility level for sustainable operation and expansion. Financial analysis results strengthened this conclusion with a Benefit-Cost Ratio (BCR) of 1.80, Net Present Value (NPV) of IDR 1.48 billion, Internal Rate of Return (IRR) of 52.84%,

and Payback Period (PP) of 6.01 years. These indicators demonstrate that Bedhag Kopi's business is economically viable and capable of generating positive returns under moderate risk exposure.

Table 2 summarizes the overall DSS assessment results, while Figure 3 visualizes the multi-aspect feasibility index distribution.

Table 2. Multi-Aspect Feasibility Scores of Bedhag Kopi (DSS Version 2.0 Output)

Aspect	Feasibility Score (%)	Classification
Legal	85.0	High
Human Resources	78.2	Moderate
Production	82.5	High
Marketing	80.1	Moderate
Environmental	79.6	Moderate
Financial	88.3	High
Overall	83.6	Highly Feasible

Table 3 presents the synthesized results of the Decision Support System (DSS) analysis, highlighting the multi-dimensional performance of Bedhag Kopi's Robusta coffee enterprise. The table demonstrates that financial and legal aspects achieved the highest feasibility scores, suggesting that the business is well-structured, compliant, and financially sustainable. These results align with the quantitative indicators presented earlier, where the BCR, NPV, IRR, and PP collectively confirm economic viability. The relatively moderate scores in marketing, human resources, and environmental dimensions reflect the enterprise's dependence on conventional operational strategies and limited digital marketing adoption. Such findings provide essential insight into areas that require targeted managerial attention and strategic development interventions.

The consistency between financial performance and operational structure indicates that the enterprise possesses a stable foundation for growth. However, the moderate rating in environmental sustainability highlights the potential need for integrating green practices into production and packaging processes. This dimension is particularly relevant given the current shift in global consumer preferences toward eco-friendly and traceable agricultural products. Enhancing waste management systems and adopting biodegradable packaging would not only elevate Bedhag Kopi's environmental performance but also improve its market competitiveness in the premium coffee segment.

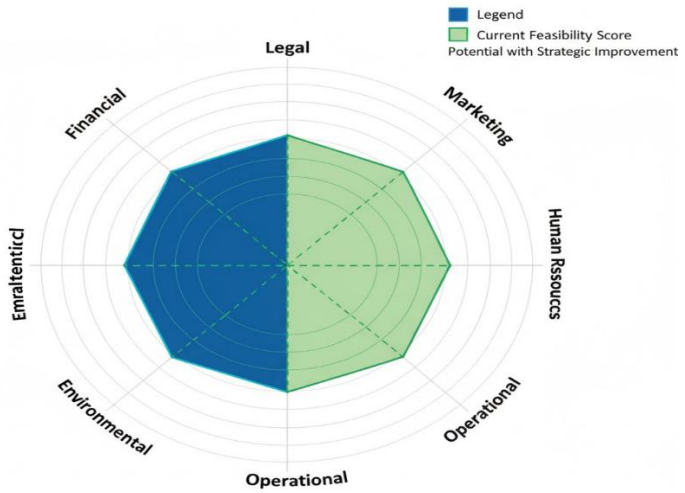

Figure 3. DSS Multi-Aspect Feasibility Visualization

The DSS output also generated automatic recommendations suggesting capacity expansion, digital marketing enhancement, and training-based human resource development. The environmental aspect required the implementation of sustainable packaging and waste utilization strategies. These findings emphasize that while Bedhag Kopi's operations are financially robust, strategic interventions in marketing and human capital could further improve sustainability.

Discussion

The findings reinforce the critical role of Decision Support Systems in facilitating structured, data-driven decision-making within small and medium rural enterprises. DSS implementation transformed Bedhag Kopi's management processes by integrating quantitative financial analysis with qualitative operational insights, aligning with prior evidence that digital tools improve strategic foresight and investment decisions (Raina et al., 2025). The integration of DSS enhanced business transparency and minimized subjective judgment, particularly in evaluating cost-benefit scenarios (Williams et al., 2025). This aligns with global efforts to strengthen digital literacy and entrepreneurship innovation in rural economies through technology-enabled solutions (Blečić et al., 2025).

From a financial perspective, the BCR and IRR values confirm the business's profitability and sustainability potential. These results align with D'Adamo et al. (2025), who emphasized that DSS-based feasibility analyses ensure rational capital allocation in small enterprises. Similarly, Martins et al. (2025) demonstrated that incorporating computational decision frameworks enhances the precision of resource utilization planning. The DSS's ability to integrate financial indicators into multi-criteria assessment allows microenterprises to identify strategic priorities that were previously analyzed intuitively. Consequently, Bedhag Kopi's financial robustness can serve as a benchmark for digital feasibility applications across other agribusiness sectors in developing regions.

The moderate scores in marketing and human resource dimensions reveal the necessity of combining digital innovation with capacity-building initiatives. Research by (Balouei Jamkhaneh et al., 2022; Vrontis et al., 2022) suggests that digital empowerment in entrepreneurship requires complementing technology adoption with human capital strengthening to ensure sustainable competitiveness. Bedhag Kopi's marketing structure, which remains conventional and localized, illustrates the challenge of limited exposure to e-commerce and digital branding tools. Previous studies confirm that DSS-driven analytics can be integrated with digital marketing platforms to improve product visibility and customer segmentation (Fakhroleslam, 2025). Therefore, targeted training and system integration are essential to amplify market reach and optimize brand communication.

In environmental terms, the moderate performance underscores the opportunity for DSS to support eco-efficiency modeling, as evidenced in sustainable enterprise frameworks (Williams et al., 2025). Integrating DSS into waste management, energy optimization, and eco-design can transform Bedhag Kopi's operation toward a circular business model. Similar frameworks in renewable energy communities show that multi-criteria DSS models effectively balance profitability and ecological performance (Blečić et al., 2025). Hence, the current findings not only validate DSS feasibility in financial domains but also highlight its untapped potential for advancing sustainability transitions in rural microenterprises.

Another key insight is the system's adaptability to dynamic market environments. (Steininger et al., 2022) demonstrated that algorithmic-based DSS enhances financial resilience by identifying early warning signals of market volatility. For Bedhag Kopi, this adaptive mechanism allows sensitivity analysis under different cost and price scenarios, strengthening managerial agility. This reinforces the argument that digital decision systems are not merely assessment tools but dynamic enablers for entrepreneurial innovation and sustainability management (Raina et al., 2025; Martins et al., 2025).

Collectively, these results confirm that integrating DSS within rural microenterprises like Bedhag Kopi creates a strategic bridge between technology and traditional business wisdom. It validates the proposition that data-driven entrepreneurship contributes to social inclusion, economic empowerment, and environmental responsibility—core values consistent with the Journal of Social, Culture, and Environment (JOSCE)'s focus on sustainable innovation and local development.

Implications

The implications of this study are twofold: theoretical and practical. Theoretically, it extends the DSS literature by contextualizing digital decision tools within rural entrepreneurship ecosystems, providing empirical evidence from a developing economy. Practically, it demonstrates that integrating DSS into microenterprise operations enhances evidence-based decision-making, financial transparency,

and resource efficiency. Policymakers can adopt similar frameworks for evaluating rural SME sustainability, while educational institutions may utilize DSS-based training to strengthen digital entrepreneurship curricula. For business practitioners, the DSS tool provides a replicable model that simplifies feasibility analysis and long-term planning, thereby accelerating digital transformation at the grassroots level.

Limitations

This study acknowledges certain limitations inherent in its scope and methodology. The research was conducted on a single case—Bedhag Kopi—which limits the generalizability of results to other rural enterprises with different operational structures. The DSS model, while comprehensive, may not fully capture qualitative socio-cultural dynamics influencing entrepreneurship performance. Additionally, the system relies on accurate and up-to-date data input; incomplete or outdated information can influence output validity. Future studies could employ comparative or longitudinal approaches across multiple SMEs to validate model robustness and extend empirical generalization.

Suggestions

Future research should expand DSS applications into broader community-based business models, integrating sustainability indicators such as carbon footprint, life-cycle assessment, and social impact measurement. The use of artificial intelligence and machine learning within DSS could enhance predictive capabilities and scenario simulations, providing deeper insights into business resilience. Policymakers are encouraged to promote DSS literacy among rural entrepreneurs to ensure digital inclusion. Moreover, collaboration between universities, incubators, and government agencies should be strengthened to refine DSS frameworks suited for local entrepreneurship ecosystems. By addressing these recommendations, DSS-based entrepreneurship models can evolve into a transformative instrument for achieving sustainable rural innovation and inclusive economic development.

CONCLUSION

This study concludes that the integration of Decision Support System (DSS) Version 2.0 serves as an effective analytical and managerial framework for evaluating and improving the sustainability of small-scale coffee enterprises in rural Indonesia. The empirical results from Bedhag Kopi demonstrate that DSS enables comprehensive assessment across financial, operational, environmental, and human resource dimensions. The system's financial evaluation confirmed that the business is economically viable, as indicated by a Benefit-Cost Ratio (BCR) of 1.80, Net Present Value (NPV) of IDR 1.48 billion, Internal Rate of Return (IRR) of 52.84%, and a Payback Period (PP) of 6.01 years, signifying strong profitability and investment attractiveness. Beyond quantitative outcomes, the study also highlights the transformative role of DSS in enhancing managerial decision-making, promoting data-driven strategies, and aligning traditional entrepreneurship practices with the digital economy.

The research reinforces that DSS integration bridges the gap between financial performance and sustainability, ensuring balanced growth through evidence-based resource allocation and risk assessment. The moderate performance in marketing, environmental, and human resource dimensions underscores the necessity of complementing DSS adoption with continuous digital literacy training, capacity building, and green innovation initiatives. Furthermore, the DSS framework provides a scalable and replicable model that can be adapted by other rural enterprises seeking to strengthen competitiveness while adhering to sustainable business principles. The study's outcomes contribute both theoretically and practically to the discourse on digital transformation in entrepreneurship, particularly within the framework of inclusive rural development and circular economy strategies.

In line with the Journal of Social, Culture, and Environment (JOSCE) focus, this research expands the understanding of how technology-enabled decision systems can empower community-based enterprises, foster economic inclusivity, and advance socio-environmental sustainability. Ultimately, integrating DSS into rural entrepreneurship not only enhances efficiency and profitability but also

embodies a forward-looking approach toward digital sustainability and local innovation. The study thus provides a significant contribution to the growing body of literature on sustainable entrepreneurship in developing economies, offering actionable insights for policymakers, educators, and practitioners committed to bridging technology with social and environmental responsibility.

AUTHOR CONTRIBUTIONS STATEMENT

Thirafi Zein Aufar Putra Suryadipa contributed as the lead author by conceptualizing the study, formulating the research framework, and overseeing the overall research design. He developed the Decision Support System (DSS) analytical model, coordinated field data collection at Bedhag Kopi, and conducted both quantitative and qualitative analyses. He also led the interpretation of results, ensured methodological rigor, and aligned the manuscript with the thematic focus on sustainable entrepreneurship and digital transformation.

Bagus Putu Yudhia contributed to literature review development, data verification, and analytical refinement. He ensured the integration of relevant theoretical perspectives on rural entrepreneurship and digital decision-making systems. He improved the clarity, coherence, and academic quality of the manuscript, particularly in the discussion, implications, and conclusion sections. He also assisted in validating the DSS output through stakeholder consultation and expert judgment.

MohammedAlghali Alhafiz Mohamedalnour Albakri contributed to enhancing the methodological robustness and international scholarly alignment of the study. He reviewed the DSS framework from a global digital-entrepreneurship perspective, strengthened the argumentation related to sustainability and socio-economic impact, and refined the interpretation of results to ensure cross-context applicability. He also contributed to the improvement of academic language, critical analysis, and manuscript readiness for international publication standards.

All authors read and approved the final version of the manuscript and collectively take responsibility for its integrity and scholarly contribution.

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